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THE UNIVERSITY OF ALBERTA

AN INVESTIGATION INTO THE RELATIONSHIP OF AUDITORY MEMORY SPAN, LISTENING AND READING COMPREHENSION

by

© MONIQUE KHEMLANI

A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled An Investigation into the Relationship of Auditory Memory Span, Listening and Reading Comprehension submitted by Monique Khemlani, in partial fulfilment of the requirements for the degree of Master of Education in Elementary Education.

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ABSTRACT

Academic success of elementary school children depends largely on listening and reading comprehension. It was proposed that the auditory memory span which appears to have a limited capacity to retain information may affect these two aspects of the communication process. The purpose of the present study was to investigate possible relationships between auditory memory span and listening and reading comprehension.

A sample of eighty grade four children was randomly selected from the St. Albert Public School system and consisted of an equal number of girls and boys possessing at least average I.Q.

The investigation indicated that a positive relationship exists between auditory memory span as measured by Letters, Elements, Related Syllables and listening and reading comprehension as measured by listening vocabulary, listening paragraph comprehension, reading vocabulary and reading paragraph comprehension.

Analysis of the correlation matrix indicated a significant positive relationship between auditory memory span and I.Q. However, no significant correlation was found between the Unrelated Syllable Memory Span scores and I.Q. scores.

The findings further revealed that auditory memory span was more closely related to listening and reading vocabulary comprehension than to listening and reading paragraph comprehension. Listening paragraph

comprehension appeared to be relatively less dependent on the auditory stimuli.

When the subjects were grouped on the basis of their performance in the Auditory Memory Span Test, those in the high group performed consistently better on listening and reading comprehension measures than those in the low group.

Analysis of variance revealed no significant differences between the performances of girls and boys on the auditory memory span sub-tests or on the comprehension variables.

Subsequent to partialling out the effect of auditory memory span, the correlation coefficient between listening and reading comprehension continued to be significant for the total sample.

The study concluded with several educational implications and suggestions for further research.

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CHAPTER I

I. INTRODUCTION AND STATEMENT OF THE PROBLEM

> A child who fails to understand a text either cannot decode letters or else cannot understand the text for reasons having nothing to do with printed words: he could not understand even if the text were read aloud to him (Moffet, 1968, p.16).

In spite of the efforts to help students attain reading competency, we are still faced with the dilemma for some children that "Johnny does not understand what he reads". This is a common problem which many teachers and parents are confronted with in the elementary schools. This is particularly disturbing since comprehension is the main objective in any reading program (Karlin, 1942; Tinker, 1952; Spearrit, 1962; Goodman, 1969; Smith, 1971; Walker, 1973). Students' academic success is determined by their proficiency in following instructions and obtaining information from the text (Tinker, 1956; Jenkinson, 1957; Goodman, 1966). Listening and reading comprehension form essential learning aids or tools for the child in all the subject areas and it is difficult to conceive of learning ability without memory.

Several researchers, theorists and observers (Miller, 1951; Bartlett, 1932; Norman, 1969; Ausubel, 1968; Smith, 1971) have indicated that both short- and long-term memory is associated with understanding and information processing. In recent years a number of researchers (Baddeley & Dale, 1966; Waugh and Norman, 1969) have distinguished between long-term and short-term memory. The role of short-term memory span or the

auditory memory span as it affects listening and reading comprehension has not been clearly defined.

Earlier researchers (Jacobs, 1887; Smith, W., 1905; Bennette, 1916; Gray, 1925; Hunter, 1934) were interested in finding out the possible relationships between age and memory span; and between intellectual ability and memory span. Later educational researchers (Rizzo, 1939; Poling, 1953; Reynolds, 1953; Rose, 1958; Cabrini, 1963 and Rodgers, 1966) undertook to examine the relationship between auditory memory span and the reading ability of so-called retarded readers. Most studies show a positive correlation between these two parameters.

Miller (1956) has demonstrated that our capacity to process information is limited to "the magical number seven, plus or minus two". The function of this "bottleneck" span is to hold information until it can be processed. According to Miller (1956), "The span of immediate memory, however, is a measure of our ability to retain material which has already been decoded" (p.80). This finding was substantiated by Broadbent (1966) and Mandler (1967). Thus, the immediate memory span may provide a narrow channel into the working of the long-term memory by imposing certain limitations on the quantity of information that may be received, processed, remembered and recalled.

Listening and reading comprehension involves auditory stimulus input, and accurate recollection of the sequence of ideas in order to understand the main idea. It appears, that the listener or the reader calls upon his immediate memory span to retain a succession of such stimuli while he is selecting and matching cues to reconstruct the

meaning of the stimuli received to form a "thought" (Gray, 1952; Smith & Dechant, 1961; Goodman, 1966; and Howe, 1970). Thus, it is possible that there is a relationship between auditory memory span and the two main processes for acquiring information (listening and reading).

This study proceeds from the basic observation by the researcher that in a normal classroom with average ability students, there are some children who comprehend more of what they read or hear than others. Does it necessarily follow that similar differences are also present in the auditory memory span?

According to Waugh (1969), "Decline in the immediate auditory recall may mean these students have difficulty in learning" (p.55). Vernon (1960) and Myklebust (1971) are in agreement with Waugh and furthermore, they claim that a deficient auditory memory span in children influences the learning of aurally presented materials. Several other researchers (Caffrey, 1955; Duker, 1964; Waugh, 1969; and Lundsteen, 1971) have pointed out that a poor listening ability imposes limitations on the ability to read. In other words, all the above researchers appear to imply that auditory memory span may affect children's ability to learn from materials presented aurally or visually. Without really knowing what is involved in the two receptive modes of acquisition, it is difficult to determine which techniques are appropriate to enhance children's comprehension ability. The continued lack of precise knowledge of the relationships between auditory memory span and comprehension ability, both listening and reading, suggested a need for the present study (Saunders, 1931; Reid, 1962; Horowitz, 1968; and Bodian, 1974).

II. PURPOSE OF THE STUDY

The purpose of this study is to investigate the effects of auditory memory span on listening and reading comprehension in order to determine any differences existing among grade four children who have high, middle and low auditory memory span. It is further proposed to determine which of the memory span sub-tests are more related to comprehension ability.

III. DEFINITION OF TERMS

Auditory Memory Span. The ability to recall immediately and in sequence, after a single presentation, a series of stimuli presented orally.

Letter Memory Span. The number of letters which an individual could correctly recall immediately after one oral presentation.

Element Memory Span. The number of elements (syllables) within the last test item on the Auditory Memory Span for Letters which an individual could correctly recall immediately after one oral presentation.

Unrelated Syllable Memory Span. The number of unrelated words within the last test item on the Auditory Memory Span for Unrelated Syllables which an individual could correctly recall immediately after one oral presentation.

Related Syllable Memory Span. The number of words in context within the last test item on the Auditory Memory Span for Related Syllables which an individual could correctly recall immediately after one oral presentation.

Auditory Memory Span Test. The auditory memory span for Letters, Elements, Unrelated Syllables, and Related Syllables inclusive.

Auditory Discrimination. The ability to make fine differences in speech sounds as measured by the Wepman Auditory Discrimination Test.

High Auditory Memory Span Group (H.A.M.S.). Pupils who score within the upper third of the total sample on the Auditory Memory Span Test.

Middle Auditory Memory Span Group (M.A.M.S.). Pupils who score within the middle third of the total sample on the Auditory Memory Span Test.

Low Auditory Memory Span Group (L.A.M.S.). Pupils who score within the lower third of the total sample on the Auditory Memory Span Test.

IV. HYPOTHESES

The purpose of this study gave rise to the following research and null hypotheses:

Research Hypothesis 1

Grade four students' listening and reading comprehension ability will be related to the number of items they can hold in the auditory memory span.

Null Hypothesis 1

There is no significant correlation between the scores for comprehension variables and the scores on:

(a) Letter Memory Span,

(b) Element Memory Span,

(c) Unrelated Syllable Memory Span, and

(d) Related Syllable Memory Span.

Research Hypothesis 2

The I.Q. of the grade four students will be related to the number of items they can hold in their auditory memory span.

Null Hypothesis 2

There is no significant correlation between I.Q. scores and the scores on:

(a) Letter Memory Span,

(b) Element Memory Span,

(c) Unrelated Syllable Memory Span, and

(d) Related Syllable Memory Span.

Research Hypothesis 3

Girls will score higher on the Auditory Memory Span Test than boys.

Null Hypothesis 3

There is no significant difference between boys' and girls' scores on:

(a) Letter Memory Span,

(b) Element Memory Span,

(c) Unrelated Syllable Memory Span, and

(d) Related Syllable Memory Span.

Research Hypothesis 4

Grade four students who differ in the level of their auditory memory span ability will also differ in their comprehension of the materials presented aurally.

Null Hypothesis 4

There is no significant difference between the scores obtained by high, middle and low auditory memory span groups on comprehension of:

(a) Listening vocabulary,

(b) Listening paragraphs, and

(c) Total listening.

Research Hypothesis 5

Grade four students who have a longer auditory memory span are better able to comprehend what they read than those students with a shorter auditory memory span.

Null Hypothesis 5

There is no significant difference between the scores obtained by

high, middle, and low memory span groups on comprehension of:

(a) Reading vocabulary,

(b) Reading paragraphs, and

(c) Total reading.

Research Hypothesis 6

Auditory memory span will have a notable effect on the relationship between grade four students' listening and reading comprehension.

Null Hypothesis 6

There is no significant relationship between the scores on listening and reading comprehension when auditory memory span is partialled out.

The null hypotheses will be considered rejected when the probability of the results occuring by chance is .05 or less.

V. RESEARCH DESIGN

The following is an overview of the research design.

Sample

The population of the sample for this study was randomly drawn from five grade four classrooms of the two elementary schools of St. Albert R.C. School District No. 3. The final sample, consisting of 40 girls and 40 boys, was representative of a normal class and had a wide range of school achievement.

Procedure

1. All children included in the sample were required to have normal visual and auditory acuity and pass the Wepman Auditory Discrimination Test.

2. The following instruments were administered to each subject either individually or in a group situation:

(a) Letter Memory Span

(b) Element Memory Span

(c) Unrelated Syllable Memory Span

(d) Related Syllable Memory Span

(e) Durrell Listening-Reading Series Form DE, Intermediate Level.

3. Intelligence scores were obtained from the cumulative records.

4. The hypotheses were tested by determining the significance of the Pearson Product-Moment correlation coefficients, one-way analysis of variance, Scheffe Test, partial correlations (MURL 07) and the 't' Test for difference between the means of independent samples.

All testing was conducted by the researcher in a three-week period in April, 1974.

VI. LIMITATIONS

In interpreting the data of this study the following limitations should be considered:

1. No effort was made to control for the effects of past learning experiences of the students.

2. The mode of presentation of the memory span sub-tests was limited to the auditory mode, consequently this may affect the recall ability of pupils whose modality strength is visual.

3. The auditory memory span sub-tests and the scoring procedures selected restrict the kind of memory span tested to Letters, Elements, Unrelated Syllables, and Related Syllables.

VII. SIGNIFICANCE OF THE STUDY

The major aim of the present study was to find the relationships among auditory memory span, listening comprehension and reading comprehension. If the relationship among the mentioned three variables should prove to be significant then instructors would ideally consider auditory memory span skills in developing comprehension ability. It may lead educators to realize that children differ markedly in the extent to which they are able to understand and retain oral and written information.

Furthermore, this study may help to determine which auditory memory span sub-test is more closely related to listening and reading comprehension ability. Such an instrument could be used to predict listening and reading comprehension ability and to screen those pupils with a high probability of becoming disabled readers. This instrument could be efficient, quick and easily administered by the teacher to identify students deficient in auditory memory span.

Since individualization is emphasized in most elementary schools, knowledge of the children's auditory memory span may provide for needs and learning styles of some pupils.

Hopefully, this study will indicate to what extent auditory memory span affects listening and reading comprehension measures.

VIII. OVERVIEW OF THE INVESTIGATION

In Chapter I the problem was identified, and a brief description of the background and the rationale of the study was provided. Research hypotheses were stated, terms defined and the purpose was specified.

Chapter II contains the pertinent review of the literature with theoretical framework under which this study was conducted.

Chapter III presents the outline of the experimental design, testing procedures, and the research procedures used to test the hypotheses.

Chapter IV reports the results of the data analysis.

Chapter V summarizes the study, presents discussion of the findings, some implications for education, and suggestion for further research.

CHAPTER II

REVIEW OF LITERATURE

This study is based on the assumption that auditory memory span is an essential ability related to listening and reading comprehension. The purpose of this chapter is to report the literature pertinent to this research.

The results will be examined in relation to the following:

I. Research related to auditory memory span and comprehension.

II. Literature pertaining to the role of auditory memory span in listening and reading comprehension.

III. The role of auditory memory span in comprehension processes as viewed by the researchers in learning and specialists in the field of reading.

IV. The capacity of immediate memory span.

I. RESEARCH RELATED TO AUDITORY MEMORY SPAN AND COMPREHENSION

Comprehension is a complex mental process achieved by various related skills and abilities. Each contributing skill must be identified in order to help educators to develop appropriate methods of teaching listening and reading comprehension. Research, relating auditory memory span to listening and reading comprehension, is minimal. For example, McCullough (1968) expressed her concern about the need for further research in comprehension by remarking:

> When as much is known about the subskills of comprehension and interpretation as is now known about the subskills of word analysis, a more balanced program can be offered (1968, p.237).

This need is further emphasized by Simons (1971) in a critical review of research on reading comprehension. The author maintains that the knowledge of the mental processes involved in reading comprehension has not advanced since the publication of Thorndike's study in 1917.

Lack of research on the mental processes involved in listening and reading comprehension may be due to the fact that performance is covert and therefore not particularly amenable to direct observation.

On the other hand, several studies have considered the role of auditory memory span in reading comprehension. As early as 1925, Gray suggested that short-term memory span was indicative of a child's ability to read. Since then Monroe and Backus (1937) and Harris (1948) concluded that deficiency in auditory memory span was accompanied by difficulty in reading.

In 1931, Saunders, through a series of case studies of elementary school children emphasized the importance of auditory memory span for academic achievement. She indicated that children with deficient auditory memory span often confuse sound elements, make wrong associations, form poor spelling habits, and are limited in their ability to carry out instructions given in the classroom.

In a different approach to the problem, Raymond (1952) studied the

memory span and associative learning abilities of superior readers aged nine to eleven years. She used a variety of auditory memory span tests: digits forward and reversed, unrelated syllables and related syllables (sentences).. The conclusion of her study was that superior readers scored significantly higher on memory span tests of related syllables (sentences) than on unrelated syllables but the retarded readers did not display any definite pattern of differences. In general, the superior readers scored higher on all the auditory memory span tests than did the retarded readers. Her research implies that superior readers have longer memory span and are better able to organize the stimulus input than the retarded readers.

In her early study, Poling (1953) carried out research on the relationship of auditory acuity, auditory discrimination and auditory memory span of grade one children to their word recognition ability. The auditory memory span was measured by using digits forward, elements of the English language (syllables) and related syllables (sentences). She found a high correlation between the scores on the auditory memory span sub-tests and the word recognition ability. Poling (1953) incidentally concluded that children who scored low on the auditory memory span test of the Stanford Binet will almost always have reading problems. She felt that auditory memory span was part of the intellectual ability with certain auditory aspects. Her research seems to imply that a longer auditory memory span is associated with adequate word recognition ability and success in reading.

Reynold (1953) carried out a correlation study to find the relationship between auditory characteristics and the reading ability of grade

four children. The auditory memory span was measured by the Digit Span Test of the Stanford Binet. He found a significant correlation ($P < .01$) between auditory memory span and silent reading.

Rose (1958) observed that children who were referred to the Smith College Reading Clinic were reading two years or more below their grade level. Nearly all these children had scored significantly low on the auditory memory span test of the Stanford-Binet. She undertook to check the validity of these observations. Her investigation revealed that auditory memory span tests were more difficult for children with reading problems than for the average or above average child. Her concluding statement was:

> Tests of auditory memory span, as they occur in Form L of the Stanford-Binet are extremely difficult for a large percentage of pupils having severe reading difficulty (p.464).

Rodgers (1966) conducted a comparative study of the auditory memory span of retarded readers from grades IV, V, and VI with a control group of average readers. Auditory memory span was measured by digits, nonsense syllables and sentences. His results indicated no significant variability between the retarded and the average readers on any of the auditory memory span tests with the exception of memory span for "digits backwards". These results are in agreement with Stauffer (1948) and Johnson (1955). He surmised that repeating digits backwards may involve higher cognitive skills wherein the reader has to hold in mind a sequence of stimuli while operating upon it at the same time. Perhaps, a disabled reader is not able to perform two tasks simultaneously; that is, to hold the sequence and also repeat it.

Cabrini (1963) undertook a descriptive study of the relationships of reading ability to auditory memory span and to functional articulatory disorders among 148 second grade pupils attending the reading clinic. The Metreaux Auditory Memory Span Tests for Digits and Nonsense Syllables were administered. Her study revealed that 62% of her cases were deficient in their ability to recall verbal material. The researcher's concluding remark was that "brevity of auditory memory span may be a factor which impedes ability to read well" (p.27).

Spearritt (1962) undertook to investigate whether there existed a separate ability called listening comprehension. A battery of thirty-four tests comprised of measures of inductive and deductive reasoning, reading comprehension, attention, auditory memory span, and listening comprehension was administered to 400 grade six Australian students. Auditory memory span was measured by letter span and words in isolation. While the majority of the findings did not relate to the present study, one was of particular interest. The factor analysis of the test results identified a separate factor called listening comprehension of verbal material presented in spoken form and this factor correlated positively with auditory memory span.

In contrast to some of the studies mentioned, Kleuver (1968) using Guilford's model (1967), the Structure of Intellect, reported no significant difference between the performance of the reading disability group and the control group on the various auditory memory span tasks of grade four students. On the basis of his findings the researcher's concluding remark was:

> There are differences in the way in which normal children and those with reading disabilities perform on tests of memory if we analyze which of the sensory systems are involved. Visual memory seems to be significantly poorer for reading disabilities children, whereas the auditory memory does not discriminate between these children and the normal readers (p.83).

Eagan (1970) used numbers, syllables and sentences to measure the auditory memory span. In her investigation of the relationship between auditory discrimination and auditory memory span, she found a significant correlation. There appeared to be a consistent development of auditory memory span from kindergarten through grade three. These findings were substantiated by Gavin (1972) and Goetz (1972).

In a longitudinal study, Goetz (1972) investigated the development of hearing skills of children from six months before and six months after they began school. Goetz found a significant correlation between the Betts Test of Related Syllables and the comprehension subtest from the Neale Analysis of Reading Ability.

On the assumption that individuals differ in their performance on learning tasks, Shuell and Giglio (1973) undertook to examine whether similar differences persisted on the auditory memory span tasks among grade five students. The stimulus materials used to measure the auditory memory span consisted of strings of three, five and seven consonants which were to be recalled in the order of the presentation. The learning ability was defined as the performance of each subject on a free recall test and was measured by the number of consonants and words recalled regardless of the order of the stimulus presentation. The

researcher showed that although there were differences in learning ability of the sample, similar differences did not exist in the memory span for immediate recall. On the basis of these results, they surmised that differences in learning ability may be associated with the individual's previous learning or the ability to apply this past learning to the given task at hand. The investigators appeared to suggest that individual differences in learning ability were not related to the indicidual differences in the immediate memory span but rather these differences are associated with the ability to apply previously learned information. These interpretations were consistent with those expressed by Carver:

> The vague concept of understanding may therefore be defined in terms of information stored, at least in the area of reading and auding prose materials (1973, p.82).

The relationship between memory for immediate recall of sentences and the comprehension of prose material was studied by Mistler-Lachman (1974). His subjects were 96 college students. Memory span for sentences was assessed by two different methods: one score was given for meaning recall and another score was for correct word sequence recall. The results showed that greater depth of comprehension of the prose material and immediate recall of sentences were significantly related. The outcome of his study suggests that better understanding is accompanied by better recall. His concluding statement was:

> The results of the present study suggest that memory measures provide a reasonable, if not perfect, estimate of initial comprehension (p.106).

II. LITERATURE PERTAINING TO THE ROLE OF AUDITORY MEMORY SPAN IN LISTENING AND READING COMPREHENSION

> Reading must involve some level of comprehension. To understand how children learn to read, we must learn how the individual experiences and abilities of children affect their ability to use language cues. We must also become aware of the differences and similarities between understanding oral language which uses sounds as symbol-units and written language which depends on graphic symbols (Goodman, 1964, p.639).

Listening and reading comprehension, the two primary channels of verbal symbolic input, are the main determining factors for academic success (Jenkinson, 1957; Strickland, 1962; Laban, 1963). Essentially, listening and reading involve the same mental processes and both call for the reception of ideas or messages. In each case meanings and ideas have to be held in the auditory memory span before any associations are retrieved from the long-term memory. As Biggs (1969) explains, the problem is not of storage within the cortex but "of putting the information into store, and of retrieving it from the store later on" (p.18).

However, certain important differences between listening and reading must first be considered. Listening is processing of spoken language which is temporal in dimension while reading is processing of spatially displayed language. The input for reading is visual, involving graphic symbols while the input for listening is auditory involving sound-symbols all of which form into a sequential pattern of phrases, sentences or paragraphs. In reading the child can proceed at his own pace and even pause for a reflection but in listening the rate, variation in pitch, stress, intonation and gestures of the speaker become quite important.

In reading, the words not only have to be recognized by the reader, but have to be organized into chunks or "thought units". In listening this is accomplished to a large extent by the speaker. Thus, it may be said that cues are provided for both, the listener and the reader, but the cue selection differs in each case(Walker, 1973).

However, as Moffet (1968) indicates in his Language Arts Curriculum Handbook, the ability to comprehend operates independently of the mode of presentation of the material:

> A child who fails to understand a text either cannot decode letters, or else cannot understand the text for reasons having nothing to do with printed words. He would not understand even if the text were read aloud to him. In other words, reading comprehension is merely comprehension (1968, p.16).

Moffet also maintains that if a reader can translate print into speech with normal intonation patterns and yet does not comprehend, then the problem is concerned not with reading, but with thinking. Listening and reading comprehension form the most essential learning tools for the child in all his subjects. Any type of learning must take into account the important component "memory". Learning and memory must be regarded as integral factors. As Furth (1969) says, "Every conceivable aspect of learning could be theoretically explained as a direct effect of "memory" (p.148). Memory is the ability to associate, retain, and recall experiences which enhance academic achievement. It appears that immediate memory span as well as the long-term memory are crucial to the process of comprehension (Myklebust, 1954; Broadbent, 1966; Goodman, 1967; Wardhaugh, 1969; Jackson, 1970; Smith, 1971). Furthermore, Goodman (1967)

maintains that the knowledge of phonological, syntactic, and semantic cueing systems is stored in the long-term memory and is constantly used as a basis for searching, selecting, and matching cues from the passage read or audited. The reader or the listener must use his cognitive as well as his linguistic ability to reproduce a probable utterance by selecting the most productive cues, and matching his prediction to the meaning of the content for appropriateness. The cues selected from the passage are temporarily stored in the immediate memory span or the auditory memory span while proper associations are being made in the long-term memory. Bloom (1956) refers to this stage as the "interpretation phase" whereby ideas are reordered into a "new thought". This stage according to Bloom (1956) and Goodman (1970) is quite complex as it involves understanding the author's ideas, seeing networks of relationships, and judging the relevance of these concepts to the context of the passage. The cues that were stored in the auditory memory span are either accepted or rejected depending on several factors such as the reader's or the listener's background of experience, his semantic memory, past experiences and his awareness of the redundancy in the passage. Because of the limited capacity of the auditory memory span, the incoming information displaces the information previously contained, resulting in no comprehension of the lost material.

All verbal stimulus input, as indicated earlier, must pass through the auditory memory span. This acts as a "gateway" of the mind determining the amount of information entering long-term storage (Miller, 1956; Atkinson, 1968; Bartz, 1968; Biggs, 1968).

Several researchers (Conrad, 1962; Wickelgren, 1965; Broadbent, 1966; Sperling, 1967; Howe, 1970) maintain that immediate memory span is sensitive to auditory characters and uses either an auditory or a speech-motor code for at least part of the trace. This factor suggests that although the stimulus may be visual -- as in the case of reading -- it is transferred into the auditory code before it is processed.

However, it is necessary to understand that auditory memory span is an integral part of the overall memory system. Consequently, it may be assumed that it is closely linked with the child's comprehension ability. There is very little empirical evidence indicating specifically how the limited capacity of the auditory memory span affects listening and reading comprehension ability.

Today, all schools emphasize comprehension as a major consideration and teachers are continually demanding more efficient and effective methods to aid students in understanding classroom instructions and textbook content. Prior to handing out a neat package of comprehension methods to the teachers, it is mandatory to investigate the relationships of auditory memory span to the two central aspects of acquiring information (listening and reading).

III. THE ROLE OF AUDITORY MEMORY SPAN IN COMPREHENSION PROCESSES AS VIEWED BY THE RESEARCHERS IN LEARNING AND SPECIALISTS IN THE FIELD OF READING

The most advanced and exciting brain research now being conducted is directed toward discovering how the brain

> perceives, processes, and stores information (Time, 1974, p.36).

This section will examine some of the viewpoints expressed by writers in order to shed some light on the function of the auditory memory span as it relates to the process of comprehension. The way we receive, decode and process the verbal stimuli is still a mystery which has not been completely solved. Several writers have postulated theories about the way we comprehend messages presented visually and aurally. Most theorists (Chomsky, 1957; Miller, 1969; Goodman, 1970; and Howe, 1970) have agreed that both short and long-term memory are operative in listening and reading comprehension, particularly if accurate recollection of the sequence of ideas is essential to understand the main thought. There are two contrasting viewpoints as to the function of immediate memory span in comprehension. There is the sequential word-processing model of comprehension in which it is maintained that immediate memory span is called upon while constructing the meaning of a sentence from its separate parts, particularly if the meaning of the word is unknown and must be determined from its context. According to Gray (1952), "As meaning associations are aroused, they are fused into a sequence of ideas. To do this the good reader holds in mind the meanings of the first words of a sentence until those that follow are recognized" (p.15). Spache (1966) also considered the role of immediate memory span with various levels of comprehension tasks. He appears to support Gray's contention and this is particularly noted in his definition of paragraph comprehension:

> To comprehend a paragraph, the reader must be able to keep in mind the ideas contributed by the successive sentences until the end of the passage (p.70).

In contrast, Goodman (1969) has shown that when we read for comprehension, we are forced to play what he calls a "psycholinguistic guessing game". Goodman (1970) believes that the language user selects the most productive cues and predicts the message on the basis of semantic and syntactic features stored in his long-term memory. In Goodman's (1970) words:

> Reading, like listening, is a sampling, predicting, and guessing process (p.15).

Goodman (1970) and Smith (1971) strictly reject the sequential processing principle of comprehension. These writers maintain that we do not hold every word in our short-term memory storage due to the limitation imposed by the immediate memory span. Goodman (1973) observes, "It must be understood that in the reading process accurate use of all cues available would not only be slow and inefficient, but would actually lead the reader away from his primary goal which is comprehension" (p.26).

Smith (1971) is in agreement with Goodman (1973) on his psycholinguistic model of comprehension. He maintains that semantic and syntactic sequential redundancy of the language provide internalized sources of information which reduce the load in short-term memory storage. He explains "...when we read for meaning we do not actually put the words into short-term memory, but instead use the visual information directly for comprehension" (p.201).

Horowitz (1968) suggested a model of the comprehension process which is an adaptation of sequential word processing and the psycholinguistic models. He maintains that we do not hold each word of the passage in our

immediate memory span but that we hold the gestalt and the language elements while reconstructing the message.

Biggs (1969) reported as a result of his study with the first year college students that individuals with a long memory span have a definite advantage in carrying out strings of thought over a person with a short one. His concluding statement was that "low intelligence and narrow memory span go together, but not high intelligence and wide memory span" (p.29).

In summary, the process of comprehension involves the principle of selecting the productive cues and reconstructing the message on the basis of the gestalt acquired and the knowledge of the language stored in the listener's or the reader's long-term memory. The attempts to be specific about the role of auditory memory span as it affects listening and reading comprehension have been controversial and for this reason it seems essential to investigate this problem.

IV. THE CAPACITY OF IMMEDIATE MEMORY SPAN

> Primary memory is best illustrated by a person's ability to recall verbatim the most recent few words in a sentence that he is hearing or speaking, even when he is barely paying attention to what is being said. Indeed, we believe that it would be impossible to understand or to generate a grammatical utterance if we lacked this rather remarkable mnemonic capacity (Waugh and Norman, 1969, p.94).

It is generally believed that an average person is capable of remembering not more than nine or ten items after a single presentation.

One of the conclusions Miller (1956) reached in his classical article "Magical Number Seven" was that immediate memory span was limited to about seven, plus or minus two units of information. However, other researchers (Smith, 1954; Cohen, 1955; Bousfield, 1956; and Miller, 1956) indicate that it is possible to increase the immediate memory capacity by increasing the information contained in each item of the seven, plus or minus two. Various strategies may be adopted to enhance the amount of information that may flow into the long-term memory. Miller (1956) suggests that one way of overcoming the bottleneck capacity is by recoding or chunking the stimulus input. As Miller (1956) points out:

> We can increase the number of bits of information that it contains simply by building larger and larger chunks, each chunk containing more information than before (1956, p.94).

Current experiments and observations (Kimble, 1965; Bodian, 1974) appear to support a three-level theory of memory: the immediate memory span or the short-term storage; the short-term memory and the long-term memory. This once again is a controversial issue among the researchers (Deutch, 1969; and Wickelgren, 1969, 1973). Throughout this study the dichotomy of memory will be considered: Short-term memory capacity and long-term memory.

The main interest of this study is in the capacity of the immediate memory span and its impact on listening and reading comprehension. The maximum capacity of this span which is seven, plus or minus two (Miller, 1956; Mandler, 1968) imposes severe limitations on the amount of information that we are able to receive, process and remember at any one time.

Every verbal item that is attended to enters the immediate memory span. Here the stimulus input is held temporarily while it is being located or processed. This input could be easily lost or forgotten unless there is an internal rehearsal to recycle the information within the immediate memory span (Figure 1). Any distraction of attention may apparently cause complete forgetting (Milner, 1957; Broadbent, 1958; Wickelgren, 1968). Some researchers (Hunter, 1934; and Broadbent, 1958) maintain that attention and short-term memory capacity have common processes but they differ in temporal duration of the stimulus. Norman (1969) aptly displays how this might operate (Figure 1).

THE FLOW OF THE STIMULUS INPUT

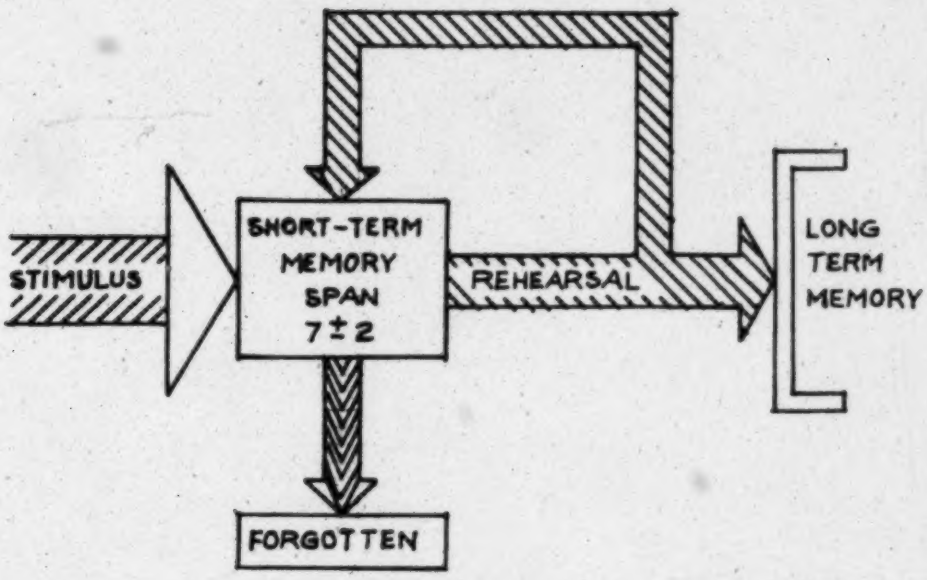

FIGURE 1

Smith as early as 1905 showed that it was possible to have a good memory span and poor long-term memory or vice-versa. Giglio and Shuell corroborated Smith's findings in 1973. The researchers maintained that deficiency in registration of the stimulus input may result in poor immediate memory, immediate recall, and slow learning. On the other hand, a child may have the ability to repeat, parrot-like, the context of a message, but may lack the ability to reorganize or chunk the content. Generally, this results in forgetting since the learner is unable to make quick associations (Miller, 1963). It is easier to learn new material in the form of sentences or paragraphs by organizing them on the basis of the number of chunks that could fit into the immediate memory span. Miller (1956) calls this process "recoding", which is a valuable tool to break through the bottleneck capacity of the memory span. Recoding would reduce the number of memory units (chunks) to be stored while increasing the amount of information per unit. Meaningful materials are efficiently processed and stored in the memory mechanism (Ausubel, 1965; Smith, 1971; Goodman, 1973).

The principle issue yet remains to be resolved: Is memory span part of the process of remembering or is it just a passive reverberating echo? (Waugh, 1969). In general, there is enough evidence in literature to suggest that auditory memory span may be measured by letters, word elements, unrelated syllables, and sentences. Literature also appears to give some indications of the possible relationships between auditory memory span and the two aspects of comprehension, mainly listening and reading. The memory span is limited to the range of seven, plus or minus two 'bits' of information. It is clear that relevant properties

must be held in the memory span while associations are being made; therefore, memory span will place an upward limit on processes of listening and reading comprehension. The above theoretical network is fundamental to this study which is designed to investigate empirically whether the performance in listening and reading depends on the length of the auditory memory span. In addition, this investigation may also indicate which of the auditory memory span sub-tests are more closely related to listening and reading comprehension.

V. SUMMARY

Reviewed literature tends to suggest that auditory memory span is related to the reading abilities of retarded readers, but this literature fails to indicate the effect of auditory memory span on the reading abilities of the average and the above average child. Several writers, without giving any indication of the role of the auditory memory span, have associated the ability to comprehend with the long-term memory.

Despite the importance of auditory memory span as a part of the total memory system, there has been little effort to integrate its function with the processes of listening and reading comprehension. Of all the studies cited, only one study incidently sought to establish the relationship of auditory memory span to listening and reading comprehension. In conclusion, the relationship of auditory memory span to listening and reading comprehension has been the subject of much debate. These debates have relied on little empirical evidences. Therefore, the major reason for carrying out this investigation is to determine the

effect of auditory memory span on listening and reading comprehension. The following chapter describes the design for such a study.

CHAPTER III

THE EXPERIMENTAL DESIGN

This chapter describes the experimental design of the study which includes the following information: sample selection, test instruments, reliability, administration and scoring of the instruments, pilot study, method of data collection, and the treatment of the data obtained by statistical procedures.

I. DESIGN OF THE STUDY

The main purpose of this study was to investigate the relationship between auditory memory span and the two receptive modes of communication, namely, listening and reading comprehension. The child's ability to hold items of information in his auditory memory span was hypothesized to be correlated with his ability to comprehend material presented aurally, or visually. A random sample of 80 grade four students were evenly chosen with equal distribution over sex.

A Grade four population was considered most suitable for this particular study as it was felt that by this grade students would have established the basic reading skills and would have received some formal instructions in comprehension. Fagan (1969) in his research points out that students in grades four and five demonstrate a great increase in their understanding of syntactic structures found in the basal readers.

However, the nature of this study demands that a child have a basic vocabulary, knowledge of letters and the ability to read at least at the Grade Two level.

II. SAMPLE SELECTION

The original test sample for this study consisted of 106 Grade four students randomly selected from the two elementary schools within the St. Albert Catholic School system. At the time of testing, there was a total enrollment of 195 Grade four students under the same school board's jurisdiction. Two classes were selected randomly from one school where students had been randomly assigned to a classroom teacher. In the second school, students had been streamed on the basis of their academic performance and other predetermined criteria. Forty students were randomly selected from the latter school.

Of the 106 randomly selected students, 80 students were included in the final sample with equal distribution of both sexes: 40 girls and 40 boys. The sample appeared to be within the range of middle socio-economic status according to the cumulative records.

III. SCREENING TESTS

Perceptual efficiency may effect the performance on the auditory memory span sub-tests and the comprehension tasks (Myklebust, 1954), therefore, students were screened for visual acuity, auditory acuity and auditory discrimination. Students' medical records at the St. Albert

Sturgeon Health Unit were investigated to identify subjects with perceptual problems, speech impediment and other problems in this area.

a. Visual Screening

Since visual screening is considered a prerequisite in perceiving any kind of symbols (Goins, 1958, p.2), students were tested for near and far point vision with the orthorator. This instrument is designed to assess visual acuity for near and far point fusion difficulties, depth perception, nearsightedness, and far sightedness. Three students were eliminated from the sample as a result of poor vision which had not been corrected.

b. Auditory Acuity and Speech Difficulties

The pure-tone audiometer had been utilized to test the students' hearing level of normal speech. A minimal criterion for passing the test was set at a correct response for each word presented at 15 to 20 decibels for all frequency levels.

It was decided to test for auditory acuity if listening comprehension scores were not to be penalized by the subjects' inability to receive the sensation of sound without distortion. Nine students had to be eliminated due to inadequate auditory acuity or other auditory impairment.

c. Auditory Discrimination

The remaining students in the sample were administered the Wepman Auditory Discrimination Test to ensure that the students selected were able to recognize the differences between the phonemes used in the English

language. This screening device was again a prerequisite measure for listening comprehension. Research supports the idea that although some children may pass the auditory acuity test, and have normal hearing, they fail to distinguish between similar sounds in minimal pairs (Monroe, 1932; Myklebust, 1954; Wepman, 1960; Eagan, 1970; Oberg, 1970). The Wepman Auditory Discrimination Test, Form has 40 items composed of 80 words in minimal pairs. This test was administered individually by the researcher. To provide consistency in presentation the test was taped. Eight students who did not meet the criterion for passing the test (Wepman, 1958; Dykstra, 1966) were deleted from the final sample.

d. Intelligence

Further reference was made to each child's cumulative record card for age, sex and intelligence. Students had been administered the Canadian Lorge-Thorndike Intelligence Test in February, 1974 which was exactly two months prior to data collection. Three students had to be excluded from the final study as no records of their I.Q. scores could be found.

As indicated, the sample size was predetermined to be eighty and it was felt necessary to have equal numbers of each sex in the sample for comparison of performance of the sexes. Of the resultant eighty three students succeeding on the screening device, three boys were randomly deleted from the sample. A summary of the group's chronological age and I.Q. is contained in Table 1.

TABLE I

A SUMMARY OF I.Q. AND CHRONOLOGICAL AGE

OF THE TEST SAMPLE (N=80)

VARIABLE	MEAN	STANDARD DEVIATION	RANGE LOWEST	RANGE HIGHEST
I.Q.	104.03	15.35	70	140
Chronological Age (months)	119.96	28.71	110	139

IV. TEST INSTRUMENTS

A. Auditory Memory Span Test*

The auditory memory span was measured by a series of four sub-tests: Letter Memory Span, Element Memory Span, Unrelated Syllable Memory Span, and Related Syllable Memory Span.

All four sub-tests were recorded on a tape to provide consistency in the presentation. All memory span sub-tests were administered individually.

1. Auditory Memory Span for Letters

The Auditory Memory Span for Letters or Letter Memory Span was constructed by Rodgers (1968) for his doctoral dissertation. Similar procedures and rules were followed in the construction of this test as was

*See Appendix for the original copy of the Test.

followed in making the Digit Span sub-test of the Wechsler Intelligence Scale. This test consists of eight series of letters. The first series begins with a span of two digits. Each succeeding series increased by one item and the ceiling of the series was nine items. In constructing the test, the following criteria had to be met:

a) The set of letters included in the test were from A to Y, except D, M, N, P, T, and A, due to the difficulty of distinguishing them and also because of the possibilities of alternative pronunciation;

b) Letters were all numbered and drawn from the table of random numbers;

c) No two adjacent letters were to be similar nor were they to be successive (e.g. C,D or B,A).

In the administration of the test, the subject was asked to repeat orally the letters in the same order immediately after the presentation. The rate of presentation was one letter per second.

The scoring procedures were similar to those of the WISC test. If a subject made a successful first attempt on a three letter span then he was given a four letter span, then five letters, etc. If the subject failed in his first attempt at the three digit span then he was given two more trials at the same level but with different sequences. Testing was discontinued after three unsuccessful attempts at a single span level. The child's digit span was determined by the length of the last span correctly repeated.

2. Auditory Memory Span for Word Elements

This auditory memory span sub-test, henceforth simply referred to as Element Memory Span, is composed of syllables which occur most frequently in the basic sight words. The test was constructed by Poling for her doctoral study at the University of Chicago in 1968. This test is modelled on the Stanford Binet in construction and format. It consists of seven graduated span levels. The first level begins with a span of a single syllable and the final level has a series of seven syllables. These syllables have a high frequency of occurrence in Thorndike's first 1000 word list and were randomly drawn for the construction of this task. Consideration was also given to the normal juxtaposition of sounds and syllables in the English language. Although nonsense syllables formed were new, they were comprised of familiar sound elements. These sound elements are considered essential for blending syllables into words (Ewers, 1950; Reynold, 1953; Poling, 1958; Shuell and Giglio, 1973). The latter indicates that a good reading ability involves knowing a large variety of sound patterns occuring in the English language. As stated earlier, the scoring and administration were derived from the memory-for-digits sub-tests of the Stanford-Binet Tests of Intelligence, 1937. Similar scoring procedures were followed as in the Letter Memory Span sub-test. The largest number of elements repeated correctly for one of the three trial items was considered to be the Child's Element Span.

3. Auditory Memory Span for Unrelated Syllables

Auditory Memory Span for Unrelated Syllables or Unrelated Syllable Memory Span is a sub-test of The Detroit Test of Learning Aptitude. It entails eight levels of span, the first level starting with one word and

the eighth level with eight words. Every span level has two trials. This test was scored according to the procedure set out in the manual of Detroit Tests of Learning Aptitude (Baker and Leland, 1967).

4. Related Syllable Memory Span

This sub-test consists of forty-three sentences getting progressively more difficult. The first sentence is composed of five words (one syllable per word) in context and the last one has twenty-two words (one syllable per word). At each span level, three trials are provided. Administration and scoring of the test was according to the procedure set out in the Examiner's handbook of the Detroit Tests of Learning Aptitude (Baker and Leland, 1967, p.69). The subject repeats each sentence after the examiner and testing is terminated if the subject makes two errors on two successive attempts. Subject's span score was determined by the length of the last correct span reproduced.

Test Reliability

The reliability of all auditory memory span sub-tests used in this study was found by using the Kuder-Richardson 20 formula. The KR-20 reliability coefficient for the Auditory Memory Span Test (total of all sub-tests) was .866.

B. Durrell Listening-Reading Series (DLRS) (Intermediate Level, Form DE)

To ascertain measures of students' listening and reading comprehension, the Durrell-Listening-Reading Series, Form DE (hereafter called DLRS) revised edition 1971 was administered. This test consists of 96 listening vocabulary words, 96 reading vocabulary words, 8 listening and 8 reading

paragraphs and 64 comprehension statements for each mode of input. The maximum administration time for both listening and reading tests is 85 minutes. Listening and reading vocabulary comprehension requires the subject to relate the given word to one of the four given categories. The listening paragraph comprehension refers to comprehension of the verbal passages presented in spoken form (Spearritt, 1962; Durrell, 1969). The listening paragraph test offers selections of contrasting statements which refer to the story heard. In answering the statements the subject is asked to classify each of the eight subsequent responses under the given categories. Reading vocabulary and paragraph comprehension tests are constructed with a similar format. The decision to use this particular standardized test was made after having considered the following criteria.

1. In the Seventh Mental Measurement Yearbook (Buros, 1972, p.1134-1137), this test received a favorable review: "This series contains at each level parallel listening and reading tests that are carefully matched for content, difficulty, type of items, and administration procedures." According to Bormuth (the reviewer), "Each of these tests is useful in its own right and compares favorably with the available tests of reading and listening " (Buros, 1972, p.1135).

2. Since the reading and listening tests were constructed parallel in content, procedure and format, they were deemed a dependable comparison of the two modes of comprehension.

3. According to the author, DRLS has a reliability coefficient of .95

for the vocabulary sub-tests and .90 for the paragraph sub-tests at each grade level.

4. Content validity of the test as indicated in the Seventh Mental Measurement Yearbook (Buros, 1972, p.1113) is satisfactory. This is mainly on the basis of item analysis and correlation between DLRS sub-tests and Metropolitan Achievement and Iowa Test of Basic Skills (DRLS manual, 1971, p.18).

5. Being a group test, it would be convenient to administer to a large sample population at one time.

6. The intermediate level of DRLS is designed for use from grades three to six, and therefore was considered suitable for grade four students.

7. Comprehension skills in DLRS are tested on a wide variety of subject matter such as social studies, science, literature and health. It was decided that a number of short passages on variety of topics would provide a more valid assessment of listening and reading comprehension than would one longer passage (King, 1959).

TABLE 2

INTERCORRELATION AMONG SUB-TESTS AND TOTAL SCORES OF THE DURRELL LISTENING AND READING TEST IN GRADE 4 (N=3183)

Tests	2	3	4	5	6
LISTENING					
1. Vocabulary	.69	.88	.72	.62	.70
2. Paragraph		.95	.63	.68	.70
3. TOTAL			.72	.71	.76
READING					
4. Vocabulary				.75	.91
5. Paragraph					..96
6. TOTAL					

V. PILOT STUDY

A pilot study using six children from the Edmonton Public School Board was conducted a month prior to the final data collection. These six children represented the high, average and the low academic achievers on the basis of their teacher's rating. The purpose of the pilot study was to investigate the following:

a) To see if there existed an obvious difference in the performance of high, average and low achievers.

b) To determine if the test instructions were intelligible to children of nine to ten years of age.

c) To determine the suitability of administration and scoring procedures of the memory tests.

d) To determine if there were any signs of undue strain or fatigue on children taking all four tasks in succession.

e) Finally, to discover the time needed to administer all the auditory memory tests.

On the basis of the results of the pilot study, the following observations and decisions were made:

a) There appeared to be some obvious differences in the performance of the students on the auditory memory tests, thus lending support to the positive relationship between auditory memory span and academic performance.

b) A discussion with the students revealed that instructions on the auditory memory sub-tests should be further clarified. It was decided that instructions as well as the test content should be tape recorded in order to provide consistency of presentation.

c) There appeared to be no undue strain or fatigue on students taking all four tasks in succession.

d) The time taken to administer all four auditory memory span sub-tests was approximately ten minutes per child.

VI. DATA COLLECTION

The data was collected between mid-April and early May, 1974. All tests, with the exception of the Canadian Lorge-Thorndike Intelligence Tests, were administered and hand scored by the researcher.

The Durrell Listening Reading Series was administered to each class as a group in their respective classrooms in two separate fifty minute sessions. The listening and reading vocabulary tests were administered

prior to the reading and listening paragraph comprehension tests.

The Wepman Auditory Discrimination Test and the auditory memory span sub-tests were individually conducted by the researcher in a comfortable, quiet, and well-lit room. If the subject did not meet the criterion for passing the auditory screening test, then further testing was discontinued and the subject was deleted from the sample. The total time taken to administer the auditory screening test and the memory tests was approximately twenty minutes.

Data on visual acuity, auditory acuity, age, sex, chronological age and intelligence quotients were secured from the cumulative record cards.

VII. ANALYSIS OF DATA

In this study, the relationship among the following variables were explored: sex, chronological age, intelligence quotient, letter span, element span, unrelated syllable span, related syllable span, listening vocabulary, listening comprehension, reading vocabulary and reading comprehension.

The data were analyzed using the following statistical procedures which have been prepared by the Division of Educational Research Services at the University of Alberta:

1. Pearson Product Moment Correlation (DEST 02)

Using the computer program DEST 02, correlation matrices were computed to determine if a linear relationship existed:

a) Between listening and reading comprehension for the total sample.

b) Among auditory memory span for Letters, Elements, Related Syllables, Unrelated Syllables, age, and I.Q. for the total sample.

c) Between auditory memory span and sex.

d) Between individual auditory memory span sub-tests in the form of Letters, Elements, Unrelated Syllables, Related Syllables, and the comprehension variables: Listening Vocabulary, Listening Paragraph Comprehension, Reading Vocabulary and Reading Paragraph Comprehension.

2. Partial Correlation (MURL 07)

The computer program MURL 07 was used for partialling out the effect of auditory memory span scores from listening and reading comprehension.

3. One Way Analysis of Variance (ANOV 15)

This procedure was used to determine whether differences existed among the high, average and low auditory memory span groups on their performance in the various comprehension measures.

4. Scheffé Multiple Comparison of Means (ANOV 15)

This procedure was used as a comparison of means following the above analysis of variance. In this way, significant difference between the means is determined.

5. One Way Analysis of Variance (ANOVA 10)

This analysis was used to determine whether differences existed between the performance of boys and girls on auditory memory span factors and listening and reading comprehension measures.

6. Uncorrelated t-Tests (ANOV 15)

't' Tests were utilized to assess the significance of the difference between the mean performances of the high, middle and low auditory memory span groups.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

The purpose of this chapter is to present and discuss the analysis of the data obtained under the following headings:

I. The performance on the Auditory Memory Span Test.

II. The performance on the comprehension variables.

III. Relationship between auditory memory span sub-tests and I.Q.

IV. Relationship of listening and reading comprehension to I.Q.

V. The effects of auditory memory span sub-tests to listening and reading comprehension.

VI. Differences in performance between boys and girls on all auditory memory span variables and all the comprehension variables.

VII. Differences in performance among high, middle and low memory span groups on listening comprehension.

VIII. Differences in performance among high, middle and low memory span groups on reading comprehension.

IX. Summary

I. PERFORMANCE ON THE AUDITORY MEMORY SPAN TEST

> The span can be considered a measure of the storage capacity of short-term memory for the class of material being tested (Cavanagh, 1972, p.525).

The ability was measured by four sub-tests: Letter Memory Span, Element Memory Span, Unrelated Syllable Memory Span and Related Syllable

Memory Span.

The results of the students' performance reported in Table 3 indicate the possible score, range score, mean score, standard deviation and the variance of the four auditory memory span sub-tests. The cohesive range scores and small standard deviations indicate that the sample was too homogeneous to make comparisons possible. The group mean on the Letter Memory Span was 4.99; Element Memory Span was 4.59; Unrelated Syllable Memory Span was 4.41; Related Syllable Memory Span was 12.5 and the total mean span for the entire sample was 26.29. Figure 2 shows the mean scores on the auditory memory span measures translated into percentage scores in order to make comparisons possible. Figure 3 indicates the frequency distribution on the individual auditory memory span sub-tests and illustrates a progressive narrowing in the range scores of memory span for Letters, Elements, and Unrelated Syllables. Memory Span for Related Syllables has a wide range of scores and these have a skewed distribution to the right. Figure 4 demonstrates the frequency distribution of the total auditory memory span scores. This narrow range in the total scores supported by a low standard deviation appears to indicate that the group's performance had little variability and thus increases the probability of the group being homogeneous.

The intercorrelations of the auditory memory span sub-tests were low but significant at the .01 level of confidence with the exception of auditory memory span for Unrelated Syllables which failed to reach the required level of significance. These low correlations indicate that the auditory memory span sub-tests were not measuring the same single ability.

TABLE 3

MEANS AND STANDARD DEVIATIONS FOR THE AUDITORY MEMORY SPAN SCORES OF THE SAMPLE (N=80)

Auditory Memory Span	Possible Score	Range of Scores	Mean Score	Mean Score as % of Possible Score	Standard Deviation
Letters	8	3-7	4.987	62.34	0.844
Elements	7	3-6	4.587	65.53	0.996
Unrelated Syllables	8	3-6	4.412	55.15	0.546
Related Syllables	22	10-17	12.450	56.59	1.890
Total	47	19-35	26.287	55.91	3.175

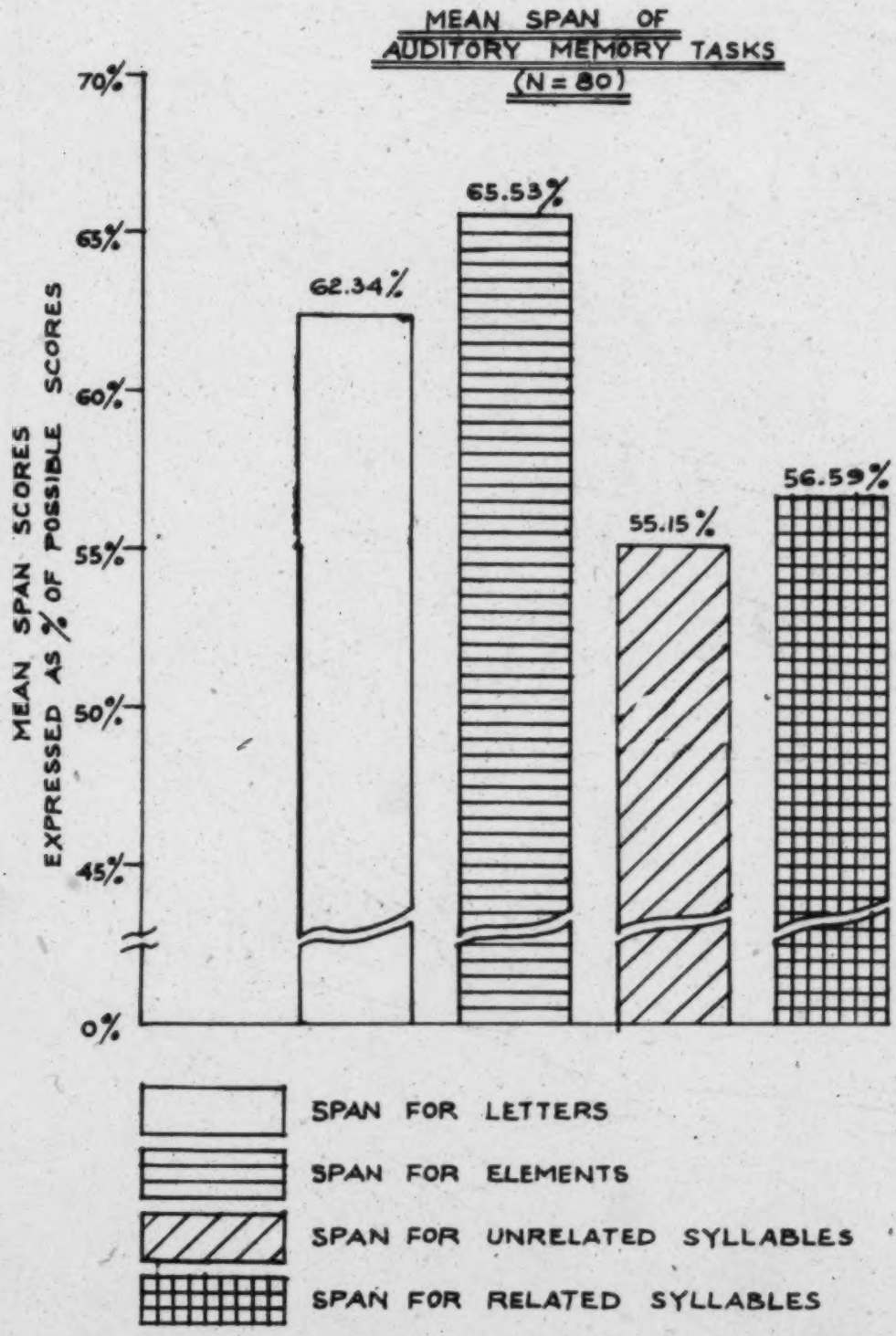
MEAN SPAN OF
AUDITORY MEMORY TASKS
(N = 80)
MEAN SPAN SCORES
EXPRESSED AS % OF POSSIBLE SCORES
70%
65%
60%
55%
50%
45%
0%
62.34%
65.53%
55.15%
56.59%
SPAN FOR LETTERS
SPAN FOR ELEMENTS
SPAN FOR UNRELATED SYLLABLES
SPAN FOR RELATED SYLLABLES

FIGURE 2

FREQUENCY DISTRIBUTION OF AUDITORY MEMORY SPAN SCORES (N=80)

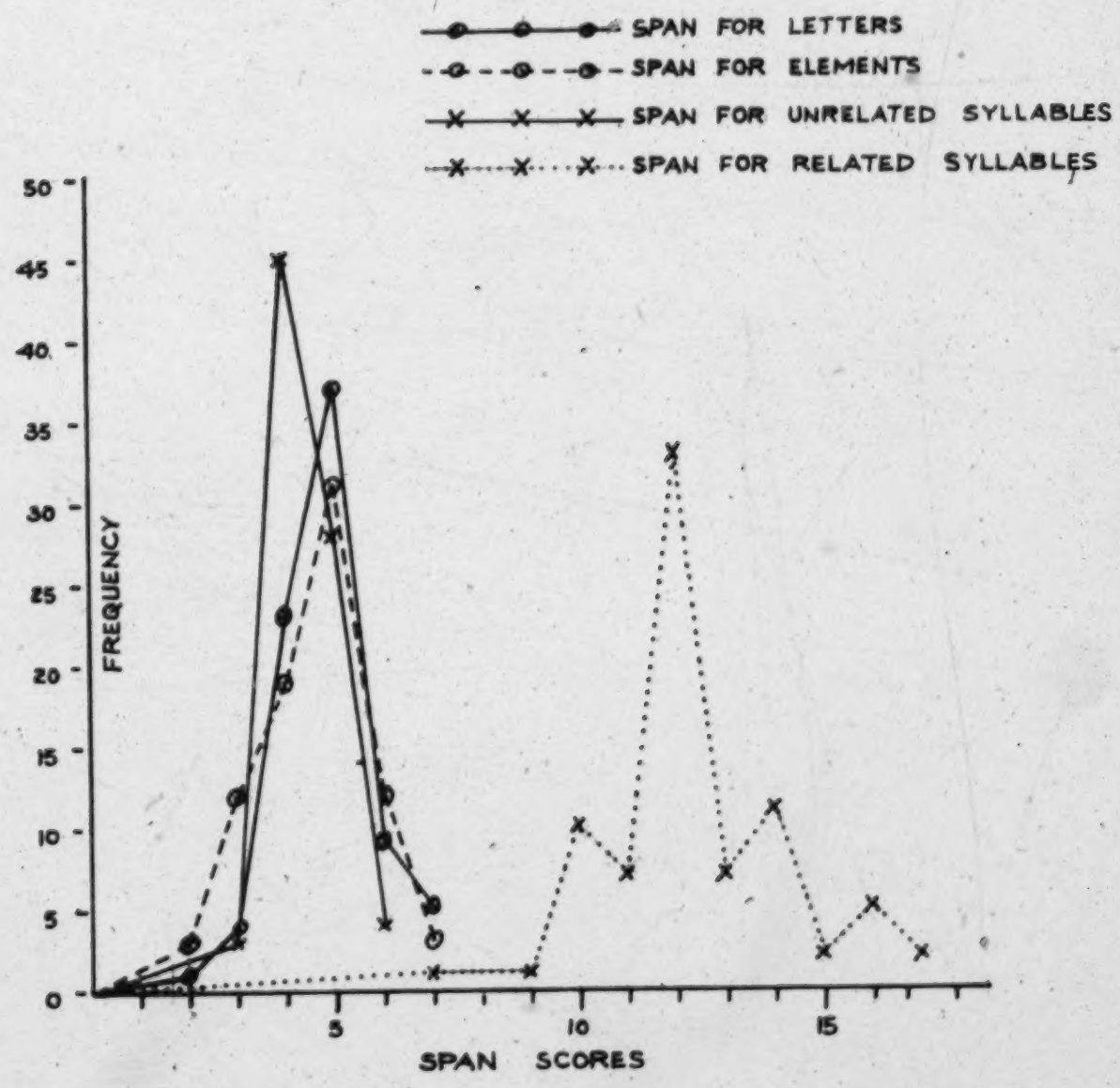

FIGURE 3

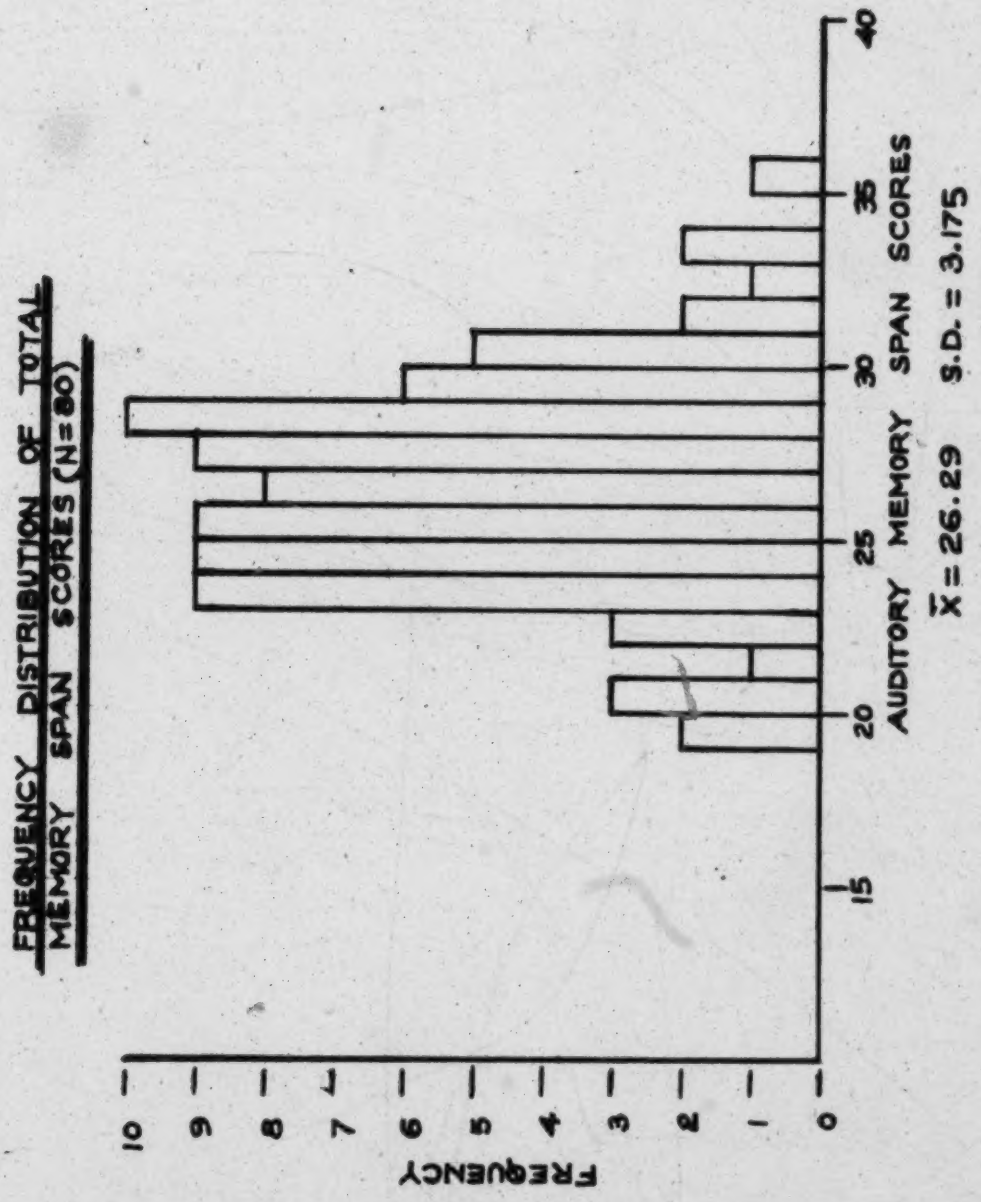
FREQUENCY DISTRIBUTION OF TOTAL MEMORY SPAN SCORES (N=80)
FREQUENCY
0
1
2
3
4
5
6
7
8
9
10
15
20
25
30
35
40
AUDITORY MEMORY SPAN SCORES
$\bar{X}$ = 26.29 S.D. = 3.175

FIGURE 4

The results are reported in Table 4.

TABLE 4

CORRELATION BETWEEN THE AUDITORY MEMORY SUB-TESTS

	LETTERS	ELEMENTS	UNRELATED SYLLABLES
Letters			
Elements	.442**		
Unrelated Syllables	.250	.301**	
Related Syllables	.378**	.292**	.349**

**Significant at the .01 level.
*Significant at the .05 level.

The mean scores and the standard deviation of the total auditory memory span for high, middle and low auditory memory span groups are presented in Table 5.

The standard deviation for the LAMS group is smaller than HAMS group. This would indicate greater variability of scores within the HAMS than within the LAMS. Scheffé multiple comparison of means indicates significant differences among the means of HAMS, MAMS, and LAMS groups with a probability beyond the .01 level of significance. Table 6 reports analysis of variance among the groups in Auditory Memory Span Test scores.

TABLE 5

MEANS AND STANDARD DEVIATIONS OF THE AUDITORY MEMORY SPAN SCORES FOR THE HIGH, MIDDLE AND LOW AUDITORY MEMORY SPAN GROUPS

	N	MEAN	S.D.
HAMS	26	32.192	12.959
MAMS	27	25.593	4.534
LAMS	27	22.667	1.7543

TABLE 6

SUMMARY OF ANALYSIS OF VARIANCE AMONG THE GROUPS FOR AUDITORY MEMORY SPAN

Test	Source of Variance	df	ms	F	P
Auditory Memory Span	Among Groups	2	628.22	10.05	0.000132**

**Significant at the .01 level.

II. PERFORMANCE ON THE COMPREHENSION VARIABLES

Data on the listening and reading comprehension were obtained by administration of the Durrell Listening and Reading Comprehension Test, Intermediate level, Form DE(DLRS). Scores on the listening test constitute a measure of the students' ability to understand the meanings of words and short passages. Similarly, reading comprehension measures the child's reading word knowledge and paragraph comprehension. Research indicates that word knowledge and reasoning in reading account for all the variances in comprehension (Davis, 1942; Hunt, 1957; Spearritt, 1962).

Sinclair (1966) examined the relationship between word fluency and reading comprehension pointing out that a fluent reader should be aware of not only the possible meaning of the word units but also the limitations imposed by the context.

Performance of the total sample on the listening and reading comprehension tests is reported in Table 7 and the correlation coefficient among the comprehension sub-tests are reported in Table 8.

The raw scores on listening comprehension ranged from 67 to 128 with a mean score of 90.39 and a standard deviation of 14.39.

Reading comprehension scores ranged from 52 to 137; the mean score was 81.36 and the standard deviation was 20.01. The reading comprehension scores were more evenly distributed with a wider range than the listening comprehension scores. The results also appear to suggest that there is

TABLE 7

MEANS AND STANDARD DEVIATIONS FOR THE

DLRS COMPREHENSION VARIABLES (N=80)

DLRS Comprehension Variables	Possible Score	Range of Scores	Mean Score	Standard Deviation	Grade Equivalent
Listening Vocabulary	96	40-74	55.637	8.528	5.5
Listening Paragraphs	64	21-53	34.537	7.759	5.2
Total Listening Comprehension	160	67-128	90.387	14.390	5.5
Reading Vocabulary	96	28-72	50.000	11.470	5.0
Reading Paragraphs	64	13-48	31.975	9.485	4.8
Total Reading Comprehension	160	52-137	81.362	20.006	4.9

TABLE 8

CORRELATION BETWEEN LISTENING AND READING VARIABLES

FOR THE TOTAL SAMPLE (N=80)

	LISTENING			READING		
	1 Vocabulary	2 Paragraph	3 Total	4 Vocabulary	5 Paragraph	6 Total
LISTENING						
1. Vocabulary		.563**	.884**	.745**	.560**	.729**
2. Paragraph			.865**	.557**	.655**	.627**
3. Total				.884**	.680**	.777**
READING						
4. Vocabulary					.837**	.729**
5. Paragraph						.839**
6. Total						

**Significant at the .01 level.

greater variability and individual differences in reading comprehension than in listening comprehension scores. It is also noted that the group's performance in listening comprehension exceeds their performance in reading comprehension. The 't' Test revealed significant variability beyond the .01 level between listening and reading comprehension. This difference is in accord with previous research which points out that listening comprehension in the elementary grades is superior to their reading comprehension (Beery, 1954; Hampleman, 1955; Eagan, 1973).

The mean scores on all the comprehension variables were converted into grade scores in order to obtain some indication of the group's performance in relation to the population on which the norms of DLRS were based. The total sample exceeded in listening comprehension by eight months from the established norms according to DLRS. Reading paragraph comprehension and total reading comprehension grades were similar to the normed grades of DLRS. The correlation coefficient between the two receptive channels of communication, namely listening and reading was .78. Corresponding results were obtained by Voice (1970). Other researchers indicate a correlation range of .5 to .8 between listening and reading comprehension in the elementary grades (Caffrey, 1955; Pratt, 1956).

III. RELATIONSHIP BETWEEN AUDITORY MEMORY SPAN SUB-TESTS AND I.Q.

Table 9 reports significant correlations at the .01 level of confidence between the mean I.Q. score and the auditory memory span sub-tests with the exception of Unrelated Syllable Memory Span which failed to

TABLE 9

CORRELATION COEFFICIENTS BETWEEN I.Q. AND THE VARIOUS ASPECTS OF AUDITORY MEMORY SPAN

Contributing Variable	Letters	Elements	Unrelated Syllables	Related Syllables	Total
I.Q.	.300**	.396**	.184	.369**	.449**

**significant at the .01 level
*significant at the .05 level

reach the level of significance. The highest correlation reached is between Element Memory Span and intelligence score (r.396, p.<.01). Similarly, Locke (1970) amd Goetz (1972) had reported positive correlations between auditory memory span and intelligence.

These results seem to indicate that the auditory memory span for Letters, Elements, and Related Syllables measures some common factors represented by intelligence tests. The memory span for Unrelated Syllables appears to be relatively independent of intelligence in this study. In general, correlations of auditory memory span sub-tests with I.Q. are low but significant at the .01 level of confidence.

IV. RELATIONSHIP OF LISTENING AND READING COMPREHENSION TO I.Q.

A comparison of the correlation coefficients between I.Q. and listening comprehension sub-tests for the total sample reveal significant

correlation beyond the .01 level of confidence. Brown (1965), Anderson and Baldauf (1963) reported a correlation between listening and intelligence ranging from 0.85 to 0.58 with fourth grade children.

Reading vocabulary and reading paragraph comprehension show the highest correlation with I.Q. These results support the findings of Robeck (1964) using elementary and junior high school students who were attending a reading clinic and Kleuver (1968) using Guilford's model of the Structure of Intellect to study the relationship of memory span and reading ability.

The findings in this section are quite reasonable and appear to indicate that comprehension variables for this particular sample are more intimately linked with the I.Q. scores than with the auditory memory span sub-tests.

In summary, it appears that correlation coefficients between I.Q. and comprehension variables are significant at the .01 level of confidence. Furthermore, the results appear to suggest that there is a closer relationship between reading paragraph comprehension and the Lorge-Thorndike Intelligence Test scores ($r=.689$, $p<.01$) than between listening paragraph comprehension and the intelligence test scores ($r=.365$, $p<.01$). The correlation coefficients relating I.Q. to comprehension variables are reported in Table 10.

TABLE 10

CORRELATION COEFFICIENTS OF I.Q. WITH
LISTENING AND READING COMPREHENSION SCORES

Contributing Variable	Listening Vocabulary	Listening Paragraphs	Reading Vocabulary	Reading Paragraphs	Total
I.Q.	.436**	.365**	.688**	.689**	.657**

**Significant at the .01 level.

V. THE EFFECTS OF AUDITORY MEMORY SPAN TASKS UPON LISTENING AND READING COMPREHENSION

Pearson Product-Moment Correlations were computed to determine the correlation coefficients, the probablities and the levels of significance among various aspects of memory span and the comprehension variables as measured by DLRS. This information is presented in Table 11.

The analysis reveals that all the correlations were positive. The Letter Memory Span correlated significantly with listening vocabulary ($p<.01$), reading vocabulary ($p<.05$) and total comprehension ($p<.01$). However the Letter Memory Span did not reach the level of significance with listening and reading paragraph comprehension. A significant correlation beyond the .01 level was found between the Element Memory Span and each of the comprehension variables with the exception of listening paragraph comprehension, where the correlation reached only the .05 level of confidence. These results are in accord with the studies

TABLE 11

COMPARISON OF COEFFICIENTS OF CORRELATIONS BETWEEN COMPREHENSION VARIABLES AND AUDITORY MEMORY SPAN TASKS (N=80)

Comprehension Scores	AUDITORY MEMORY SPAN SCORES				
	Letters	Elements	Unrelated Syllables	Related Syllables	Total
Listening Vocabulary	.325**	.401**	.143	.344**	.455**
Listening Paragraphs	.173	.258*	.038	.167	.288**
Reading Vocabulary	.241*	.362**	.096	.298**	.407**
Reading Paragraphs	.180	.315**	.083	.278**	.317**
Total Comprehension	.269**	.391**	.108	.310**	.417**

Level of significance ** $p<.01$
* $p<.05$

conducted by Miller (1969), Shulman (1971) and Wickelgren (1973). The Unrelated Syllable Memory Span had a positive, though a low correlation span, which failed to reach the .05 level of significance with any of the comprehension measures. The Related Syllable Memory Span correlated significantly beyond the .01 level with all the comprehension variables, with the exception of listening paragraph comprehension, where the .05 level of significance was not reached. Semantic and syntactic structure may have facilitated learning of the Related Syllables by some sort of "chunking" (Miller, 1956). However, total auditory memory span scores and all the comprehension variables correlated significantly beyond the .01 level of confidence. The highest correlation coefficient ($r=.455$) was between total auditory memory span and listening vocabulary. These results suggest that there is a positive significant relationship between auditory memory span tasks and all the comprehension variables. This relationship, although positive and significant beyond the .05 level of confidence, is rather low which indicates that listening and reading comprehension processes involve factors in addition to those measured by the Auditory Memory Span Test at grade four level. It would appear that the auditory memory span for Elements and for Related Syllables has a more significant relationship ($p<.01$) with the understanding of listening and reading vocabulary, than with listening and reading paragraph comprehension for this particular sample.

In general, the results indicate a positive relationship between the ability to retain items in the auditory memory span and the ability to understand meanings of words and passages presented visually or aurally. This relationship is strongest with Element Memory Span and

Related Syllable Memory Span. These findings appear to suggest that auditory memory span for English Syllables (sounds of the language) and Related Syllables (sentences) have some learning factors similar to those involved in listening and reading comprehension. Another aspect of the results appears to suggest that reading comprehension is more dependent on the auditory memory span than listening paragraph comprehension.

It was decided to assess the effect of the auditory memory span on the relationship between total listening and total reading comprehension. Correlation between listening and reading comprehension was .777 ($p<.01$) subsequent to partialling out the effect of the auditory memory span scores. The correlation between Auditory Memory Span Test and listening comprehension scores was .380 ($p<.01$) and between Auditory Memory Span Test and reading comprehension was .399 ($p<.01$). Computer program MURL 07 was used to partial out the effect of auditory memory span from both listening and reading comprehension scores. Correlation coefficients were utilized to examine the relationship between the two receptive modes of communication. Subsequent to partialling out the effect of auditory memory span, the correlation between listening and reading comprehension was slightly reduced in both cases but continued to maintain a high significant correlation ($r=.737$, $p<.01$). A possible explanation of this phenomenon may be that auditory memory span accounts for a small portion of listening and reading comprehension, as many other factors may be operative in the process of comprehension.

VI. DIFFERENCES IN PERFORMANCE BETWEEN BOYS AND GIRLS ON ALL AUDITORY MEMORY SPAN VARIABLES AND ALL THE COMPREHENSION VARIABLES

One-way analysis of variance with the computer program ANOVA 10 was used to determine if there were any significant differences between boys and girls on their performances in comprehension variables and the auditory memory span sub-tests. The mean scores and the summary of the analysis is represented in Table 12.

A comparison of the means of listening and reading comprehension measures indicated that the boys were superior to the girls on listening vocabulary and paragraph comprehension. Earlier studies (Hampleman, 1955 and Hollow, 1955) have noted that males were slightly superior to females in listening comprehension at grade four level. Girls' performance was superior on reading vocabulary and reading paragraph comprehension. However, these results may have limitations since they did not reach the statistical level of significance.

Reference to Table 12 shows no significant differences in the performance of either of the sexes on auditory memory span sub-tests or comprehension variables. These results are not entirely unexpected but rather quite consistent with other research (Eagan, 1970; Gavin, 1972).

However, another aspect of this difference is represented by a comparison of the correlation coefficient for boys' and girls' auditory memory span sub-tests and comprehension variables. This information is

TABLE 12

MEANS AND SUMMARY OF ANALYSIS OF VARIANCE BETWEEN BOYS AND GIRLS ON COMPREHENSION AND AUDITORY MEMORY SPAN SUB-TESTS

(N=80)

VARIABLES	GIRLS Mean$_1$	GIRLS S.D.$_1$	BOYS Mean$_2$	BOYS S.D.$_2$	df	F-Ratio
I. Listening Comprehension						
Vocabulary	54.27	9.70	58.00	7.40	78	1.719
Paragraphs	33.92	7.80	35.15	7.86	78	1.015
II. Reading Comprehension						
Vocabulary	52.70	11.89	48.30	11.07	78	1.154
Paragraphs	32.73	8.87	31.22	10.23	78	1.330
III. Auditory Memory Span						
Letters	4.97	.80	5.00	.91	78	1.281
Elements	4.80	1.03	4.57	.98	78	1.101
Unrelated Syllables	4.42	.64	4.40	.67	78	1.116
Related Syllables	12.57	2.07	12.32	1.73	78	1.437
Total Span	26.76	3.35	26.20	3.06	78	1.198

*The over-all F ratio was not significant.

reported in Table 13. This comparison reveals a higher relationship between the auditory memory span scores and all measures of listening and reading comprehension for girls than for boys. The memory span for Letters, Elements, and Related Syllables correlated significantly beyond the .05 level with the comprehension variables for girls but failed to reach the level of significance for boys with the exception of listening vocabulary (p .05). Conversely, the relationship between Unrelated Syllable Memory Span and listening vocabulary and total listening comprehension showed significance at the .01 level for boys but fell below the .05 level of significance for girls. Total auditory memory span

TABLE 13

COMPARISON OF COEFFICIENTS OF CORRELATION BETWEEN COMPREHENSION SCORES AND AUDITORY MEMORY SPAN SCORES FOR BOYS AND GIRLS

Comprehension Scores	AUDITORY MEMORY SPAN SCORES									
	Letter		Elements		Unrelated Syllables		Related Syllable		Total	
	Girls N=40	Boys N=40	Girls N=40	Boys N=40	Girls N=40	Boys N=40	Girls N=40	Boys N=40	Girls N=40	Boys N=40
Total Listening Comp.	.447**	.116	.414**	.268	.087	.372**	.391**	.236	.506**	.326*
Listening Vocabulary	.433**	.197	.520**	.289*	.036	.371**	.388**	.296*	.534**	.368*
Listening Paragraphs	.346*	.010	.298*	.220	.216	.280	.177	.168	.252	.212
Total Reading Comp.	.410**	.086	.425**	.279	.087	.269	.484**	.252	.577**	.324*
Reading Vocabulary	.367*	.107	.447**	.278	.040	.232	.396**	.224	.506**	.290
Reading Paragraphs	.348*	.035	.436**	.213	.129	.255	.346*	.222	.399**	.241
Total Comprehension	.423**	.101	.488**	.290	.108	.330*	.378**	.257	.493**	.380*

**Significant at the .01 level.
*Significant at the .05 level.

scores displayed consistent significant correlations with comprehension variables at the .01 level for girls and in some cases (total listening comprehension; listening vocabulary and total reading comprehension) at the .05 level for boys.

Thus with the exception of scores on Unrelated Syllable Memory Span, the relationship between auditory memory span sub-tests and comprehension variables was consistently greater for girls than for boys.

Since no statistically significant differences were found between the test scores of girls and boys, they were combined for the remaining analysis of data.

VII. DIFFERENCES IN PERFORMANCE AMONG THE HIGH, MIDDLE AND LOW MEMORY SPAN GROUPS ON LISTENING COMPREHENSION

Students in the sample were separated into high, middle and low groups on the basis of their scores on total auditory memory span. One-way analysis of variance (ANOVA 15) was applied to the data followed by the Scheffe Multiple Comparison of Means. This is a procedure for making all possible comparisons of means. It is a conservative test with respect to type one error. Table 14 shows the means and the standard deviations for the three groups. The results in Table 14 further indicate that the high auditory memory span group obtained highest scores on the listening comprehension measures and the low group scores the lowest. In general, a hierachical pattern is observed in the performance of all three groups in listening vocabulary and listening paragraph comprehension. Viewing

TABLE 14

MEAN SCORES AND STANDARD DEVIATIONS ON LISTENING COMPREHENSION VARIABLES FOR THE HIGH, MIDDLE AND THE LOW AUDITORY MEMORY SPAN GROUPS

TESTS	HIGH GROUP N=26		MIDDLE GROUP N=27		LOW GROUP N=27	
	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
Listening Vocabulary	57.00	14.80	54.22	13.20	51.37	6.95
Listening Paragraphs	34.77	10.89	33.93	10.01	32.78	7.16
Total Listening Comprehension	120.12	121.58	107.07	81.28	84.04	12.35

the relationship expressed in percentage of the possible score in Figure 5, it is observed that the variability among the three groups is low on listening paragraph comprehension.

As was indicated earlier, the performance of the groups on the auditory memory span sub-tests was too cohesive to make any significance comparison possible. However, when the Scheffé Multiple comparison of means was applied, there was no significant differences ($p \leq .05$) between the three auditory memory span groups on listening comprehension measures. Table 15 reports the summary of analysis of variance on comprehension measures for all three auditory memory span groups. The F-ratio indicates that the difference among the groups has not approached the level of significance ($p \leq .05$). As was indicated, the Scheffé Test is more rigorous than other multiple comparison methods with regard to type one error; it did not detect significant difference among the groups. Further, using the Welch 'T' prime adjustment of t'Tests for unequal variances in scores and to account for the unequal numbers in each group, the differences in the means of HAMS and LAMS were examined.* The post hoc t-Test for independent samples revealed significant difference in the mean scores of the two groups with probabilities beyond the .01 level of significance for listening vocabulary and total listening comprehension. There was no statistically significant differences in the scores of listening paragraph comprehension among the scores of high, middle and low auditory memory span groups (HAMS, MAMS, and LAMS). The results of the HAMS and LAMS groups are reported in Table 16. The findings of this

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*The statistical procedure is described in Ferguson (1966, p.148).

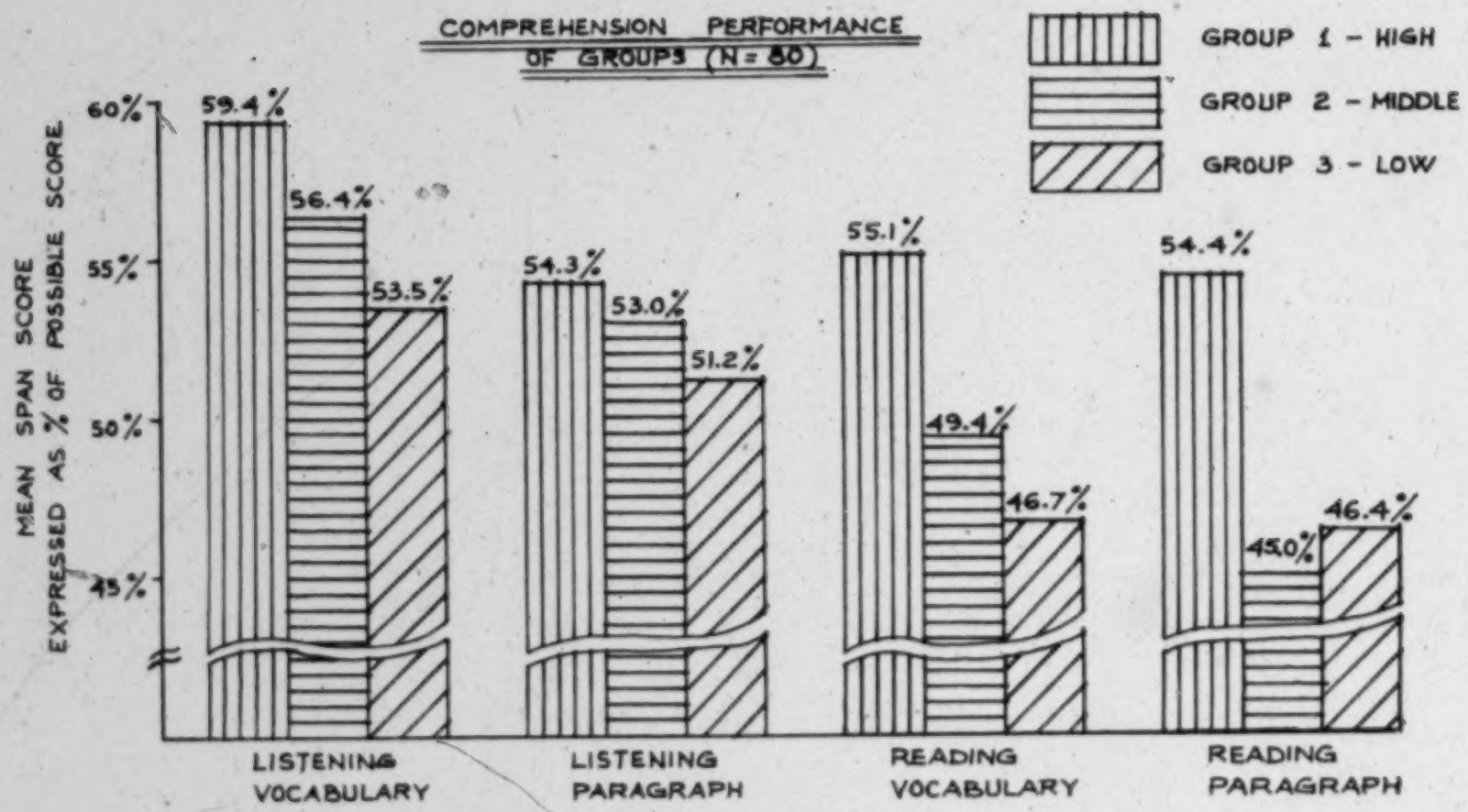
COMPREHENSION PERFORMANCE
OF GROUPS (N = 80)
GROUP 1 - HIGH
GROUP 2 - MIDDLE
GROUP 3 - LOW
MEAN SPAN SCORE
EXPRESSED AS % OF POSSIBLE SCORE
60%
55%
50%
45%
59.4%
56.4%
53.5%
54.3%
53.0%
51.2%
55.1%
49.1%
46.7%
54.4%
45.0%
46.4%
LISTENING VOCABULARY
LISTENING PARAGRAPH
READING VOCABULARY
READING PARAGRAPH

FIGURE 5

TABLE 15

SUMMARY OF ANALYSIS OF VARIANCE ON LISTENING COMPREHENSION FOR THE HIGH, MIDDLE AND LOW AUDITORY MEMORY SPAN GROUPS

	SOURCES OF VARIANCE AND SUMS OF SQUARES		MEAN SQUARES		df		F
	Among Means of Total Scores	Within Scores	Among Means of Total Scores	Within Scores	Among Means of Total Scores	Within Scores	
Listening Vocabulary	420.00	11265.00	210.00	146.30	2	77	1.44
Listening Paragraphs	53.00	6905.19	26.50	89.68	2	77	.30
TOTAL	17750.00	545309.96	8875.22	7081.94	2	77	1.25

TABLE 16

UNCORRELATED t-TEST - DIFFERENCE BETWEEN MEANS OF HAMS AND LAMS IN LISTENING COMPREHENSION

	D.F.	t-Value	P-One Tail
Listening Vocabulary	51	3.162**	.00133
Listening Paragraph	51	1.467	.07435
Total Listening Comprehension	51	3.637**	.00132

** Significant at the .01 level for a One-tail test of significance.

section suggest that the influence of auditory memory span is reflected more strongly in listening vocabulary than in listening paragraph comprehension. These results seem to suggest that deficiency in auditory memory span may be indicated by low performance in listening vocabulary.

VIII. DIFFERENCES IN PERFORMANCE AMONG HIGH, MIDDLE AND LOW MEMORY SPAN GROUPS ON READING COMPREHENSION MEASURES

To ascertain students' performance in reading comprehension, the mean scores of the high, middle and low auditory memory span groups were analyzed. The data was further treated by analysis of variance (ANOVA 15) followed by Scheffé Comparison of group means. The means and the standard deviations of each group are represented in Table 17. The results revealed that the HAMS group had the highest means, the MAMS group had intermediate position and the LAMS group had the lowest means on reading vocabulary and the total reading comprehension. No such hierachical pattern was established by the means of the reading paragraph comprehension scores between the MAMS and LAMS. The LAMS scored slightly (.88) higher than the MAMS group. The mean scores of the HAMS was greater than the mean score of the MAMS and LAMS on the reading comprehension measures. The findings in this particular section may suggest that low ability in auditory memory sequencing tasks may be accompanied by low performance in reading vocabulary and total reading comprehension. The results of the groups' performances are graphed in Figure 5 and the summary of the analysis is reported in Table 18. Once again, the Welch 'T' prime adjustment of unequal variances in scores indicated significant differences

TABLE 17

MEAN SCORES AND STANDARD DEVIATION ON READING COMPREHENSION VARIABLES FOR THE HIGH, MIDDLE AND LOW AUDITORY MEMORY SPAN GROUPS

TESTS	N=26 HIGH GROUP		N=.27 MIDDLE GROUP		N=.27 LOW GROUP	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Reading Vocabulary	52.85	15.10	47.41	15.67	45.85	9.42
Reading Paragraphs	34.81	12.38	28.82	11.45	29.70	7.34
TOTAL READING COMPREHENSION	109.92	94.22	106.96	146.66	73.48	16.06

TABLE 18

SUMMARY OF ANALYSIS OF VARIANCE ON READING COMPREHENSION FOR THE HIGH, MIDDLE AND LOW AUDITORY MEMORY SPAN GROUPS

	SOURCES OF VARIANCE AND SUMS OF SQUARES		MEAN SQUARES		df		F
	Among Means of Total Scores	Within Scores	Among Means of Total Scores	Within Scores	Among Means of Total Scores	Within Scores	
Reading Vocabulary	710.81	14395.43	355.41	186.95	2	77	1.90
Reading Paragraphs	550.94	8637.75	275.47	112.18	2	77	2.46
TOTAL READING COMPREHENSION	21945.19	787875.62	10972.59	10232.15	2	77	1.86

between the means of HAMS and LAMS.

The results in Table 19 indicate significant differences beyond the .01 level in performance on all reading comprehension measures. These results may be indicative of findings of the other researchers that the value of the auditory memory span sub-tests lies in differentiating the upper and the lower groups of the distribution. It would appear that high scores on auditory memory span are accompanied by high performance in reading vocabulary, reading paragraph comprehension, and the total reading comprehension.

IX. SUMMARY

These findings resulting from the interpretation on the data are summarized as follows:

1. The scores on DLRS indicate that the students in the sample have average ability in reading comprehension but are slightly superior in listening comprehension.

2. The sample for this study is representative of a normal class with average ability students. Thus, it may be said that average ability students have a narrow variability range of auditory memory span to make reliable predictions.

3. Neither the boys nor the girls differed significantly in their performance on the comprehension measures.

4. Neither the boys nor the girls differed significantly in their performance on the auditory memory span sub-tests. The findings of this study suggest that sex is not an important variable in the consideration

TABLE 19

UNCORRELATED t-TEST - DIFFERENCE BETWEEN THE MEANS OF HAMS AND LAMS IN READING COMPREHENSION

	D.F.	t-Value	P-One Tail
Reading Vocabulary	51	2.715**	.00451
Reading Paragraph	51	3.922**	.00013
Total Reading Comprehension	51	3.400**	.00066

**Significant at the .01 level for a one-tail test of significance.

of auditory memory span abilities.

5. The relationship of auditory memory span sub-tests scores to the comprehension variables scores was more significant for girls than for boys with the exception of Unrelated Syllable Memory Span which was more significant for boys.

6. The results indicate a significant positive relationship between auditory memory span as measured by Letters, Elements, Unrelated Syllables and Related Syllables, and the listening and reading abilities of the students at the grade four level.

7. When the students were grouped on the basis of the Auditory Memory Span Test, students in the high group scored significantly higher than the students in the low group in all the reading comprehension and listening comprehension measures with the exception of listening paragraph comprehension.

8. Correlation coefficients between the two modes of communication were positive and significant. When the effect of auditory memory span was partialled out, a high positive correlation between listening and reading comprehension was sustained.

9. The analysis of the correlation indicated that auditory memory span sub-tests, with the exception of Unrelated Syllable Memory Span, are significantly related to I.Q. scores.

10. Listening and reading comprehension appears to have a stronger relationship to the I.Q. scores than to the auditory memory span sub-tests.

11. Performances on auditory memory span sub-tests have a more significant relationship to listening and reading vocabulary than to listening and reading paragraph comprehension.

12. However, auditory memory span has a greater relationship to reading paragraph comprehension than to listening paragraph comprehension.

13. Listening paragraph comprehension appears to be less dependent on auditory memory span than does reading paragraph comprehension. This finding was further supported by the 't' Test which showed that performances of the middle and the low auditory memory span groups were significantly better in listening paragraph comprehension than in reading paragraph comprehension.

14. The Element Memory Span and Related Syllable Memory Span appear to be good predictors of success in listening and reading comprehension ability of students in the sample.

Discussion of the hypotheses, summary of the purpose, the design of the study, possible implications, conclusions drawn from the data, and suggestions for further research are included in the following chapter.

CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

I. SUMMARY

The aim of the study was to examine the relationship between auditory memory span and listening and reading comprehension. This study set out from a basic observation by the researcher that some children comprehend more than others when they listen to instructions or read a text. Furthermore, a review of the literature on the comprehension processes and on the built-in limited capacity of the auditory memory span led to the initiation of the present study.

A sample of eighty grade four children with equal distributions over sex was chosen from five classrooms within the St. Albert Public School System. The ages of the sample ranged from one hundred and ten to one hundred and thirty nine months, with a mean of 119.9 months. The intelligence levels, as measured by the Canadian Lorge-Thorndike Intelligence Test, ranged from seventy-nine to one hundred and forty, with a mean of 104.

The purpose of this research was achieved by utilizing the Auditory Memory Span Test for Letters, Elements, Unrelated Syllables (words in isolation) and Related Syllables (words in context) which measured the students' ability to retain information in the immediate memory span.

Listening and reading comprehension ability was assessed by means of the Durrell Listening-Reading Series, Intermediate Level, Form DE, which comprised of listening vocabulary, listening paragraph comprehension, reading vocabulary, and reading paragraph comprehension.

The data were analyzed by using the Pearson product moment correlation, partial correlation, Scheffé Tests, and the 't' Test.

II. FINDINGS AND CONCLUSIONS OF TEST DATA

The null hypotheses outlined in Chapter I and the conclusions reached by the investigator in relation to the testing of the hypotheses are presented below.

Hypothesis 1

There is no significant correlation between the scores for comprehension variables and the scores on:

a) Letter Memory Span,

b) Element Memory Span,

c) Unrelated Syllable Memory Span, and

d) Related Syllable Memory Span.

a) The comprehension variables include listening vocabulary, listening paragraph comprehension, reading vocabulary, and reading paragraph comprehension. A significant relationship ($p<.05$) was found between Letter Memory Span and both listening and reading vocabulary. There was no significant relationship between Letter Memory Span and

the remaining comprehension variables (listening and reading paragraph comprehension). Accordingly, the portion of the null hypothesis pertaining to the relationship between Letter Memory Span and vocabulary comprehension (both listening and reading) was rejected. The portion of the hypothesis between Letter Memory Span and paragraph comprehension (both listening and reading) was accepted.

b) There was a significant ($p<.01$) relationship between Element Memory Span and the comprehension measures: listening vocabulary, reading vocabulary, listening paragraph comprehension and reading paragraph comprehension. The relationship between Element Memory Span and listening paragraph comprehension was reduced to the .05 level of confidence. Therefore, this hypothesis was rejected for all measures of comprehension.

c) No significant relationship was found between the Unrelated Syllable Memory Span and any of the comprehension measures. On the basis of these results, the hypothesis 2(c) was accepted for all the comprehension measures.

d) A significant relationship ($p<.01$) existed between Related Syllable Memory Span and all the comprehension variables with the exception of listening paragraph comprehension. This hypothesis was rejected for all the comprehension variables, except for listening paragraph comprehension.

Conclusion

The test results suggest that the ability to retain various auditory stimuli varies with each comprehension task.

Element Memory Span maintained the highest and most consistent level of relationship with the listening and reading comprehension variables for the total sample. This finding substantiates Gray's contention that, "...inability to remember sounds is a subtle difficulty which leads to confusions and even failure in reading " (1922, p.26). Recently Shulman's (1972) finding indicated that phonemic information is stored more efficiently in the immediate memory span than the semantic information. In addition, the analysis of the data suggests that the Element Memory Span, which correlated significantly with all the comprehension measures would be a good diagnostic instrument for predicting students' listening and reading comprehension ability. However, it may be argued that correlation is not the same as prediction, but measures yielding high positive correlation with the comprehension variables merit attention as possible predictors.

Consistently significant relationships of Element Memory Span and Related Syllable Memory Span with the comprehension measures may provide some indication of how children around the age of ten retain for comprehension. The above results suggest that retention of semantic and phonemic information in the immediate memory span is an important ability which is closely associated with listening and reading comprehension. Moreover, this finding tends to corroborate Jackson's (1970) concluding statement: "Organization in memory processes appeared to

take place on the basis of semantic redundancy represented by conceptual categories but not on the basis of the linguistic category of part-of-speech..." (p.220).

Letter Memory Span and Unrelated Syllable Memory Span (words in isolation) had little or no relationship with the comprehension measures. The results on the Unrelated Syllable Memory Span seems to indicate that this test is possibly an inadequate instrument for measuring auditory memory span at the grade four level.

The present study lends support to psycholinguists (Miller, 1962; Horowitz, 1968; Goodman, 1970; Smith, 1971) who maintain that we do not hold words in the immediate memory span during listening and reading comprehension processes, but instead retain the gestalt and the language elements which are reconstructed into words, phrases and sentences during recall.

The present data indicate a strong and consistent relationship between the scores on auditory memory span sub-tests (except for Unrelated Syllable Memory Span) and vocabulary comprehension (both listening and reading). These findings suggest that listening and reading vocabulary comprehension involve a learning factor similar to that involved in the auditory memory span. The present findings tend to corroborate the conclusions of Davis (1942), Cole (1946), Harris (1956), Hunt (1957), and Laban (1966) who maintain that vocabulary development forms an essential phase of comprehension.

The findings of this section suggest that listening and reading vocabulary comprehension are closely linked with the auditory memory span for this sample.

It is noteworthy that in general, the relationship between the total auditory memory span and the comprehension measures is statistically significant at a low level which implies that auditory memory span forms only part of the over-all comprehension ability.

Hypothesis 2

There is no significant correlation between I.Q. scores and the scores on:

a) Letter Memory Span,

b) Element Memory Span,

c) Unrelated Syllable Memory Span, and

d) Related Syllable Memory Span.

a) Statistical analysis of the data revealed a significant relationship at the .01 level of confidence between I.Q. scores and the Letter Memory Span. Therefore, this hypothesis was rejected for the total sample.

b) A significant relationship beyond the .01 level was found between the Element Memory Span and I.Q. scores for the total sample. Thus, hypothesis 1(b) was rejected.

c) No significant relationship was found between the Unrelated

Syllable Memory Span and I.Q. scores for the total sample. Hypothesis 1(d) was rejected.

Conclusion

The present data tend to indicate that there is a low significant relationship between the I.Q. scores and all of the auditory memory span measures with the exception of Unrelated Syllable Memory Span which does not reach a level of significance. The low positive correlations seem to suggest that I.Q. accounts for little overlap of learning ability similar to that involved in auditory memory span tasks.

On the other hand, lack of a significant relationship between I.Q. and Unrelated Syllable Memory Span indicates the distinct functional nature of these measures. Perhaps, Unrelated Syllable Memory Span measures a learning factor which is independent of I.Q. This finding lends support to Truscott's (1970) study which revealed lack of variability in recall of random words between the schizophrenic and the normal subjects.

The Element Memory Span and the Related Syllable Memory Span maintained the highest relationship with the I.Q. scores. This commonality may account for similar verbal abilities present in these two variables. This pattern of relationships supports Hypothesis 1 and also the contention that certain phonemic, semantic and syntactic associations may be made in the immediate memory span.

Hypothesis 3

There is no significant difference between boys' and girls' scores on:

a) Letter Memory Span,

b) Element Memory Span,

c) Unrelated Syllable Memory Span, and

d) Related Syllable Memory Span.

a) One-way analysis of variance revealed no significant differences between the mean scores of boys and girls on any of the memory span sub-tests. Therefore, Hypothesis 3 is accepted for the differences between boys and girls on their performance in the Letter Memory Span, Element Memory Span, Unrelated Syllable Memory Span, and Related Syllable Memory Span sub-tests.

Conclusion

Although performance on memory span sub-tests in general seemed to favor girls slightly, this difference did not reach the .05 level of confidence. The nonsignificant differences in the mean scores of boys and girls is quite consistent with some of the studies cited in Chapter II (Kleuver, 1968; Eagan, 1970; Gavin, 1972).

The present data suggest that boys and girls do not differ in their ability to retain items in the auditory memory span. Sex does not seem to be an important variable in the consideration of auditory memory span abilities.

Hypothesis 4

There is no significant difference between the scores obtained by high, middle, and low auditory memory span groups on comprehension of:

a) Listening vocabulary,

b) Listening paragraphs, and

c) Total listening.

a) One-way analysis of variance (ANOV 15) followed by Scheffé multiple comparison of means was applied to the data to determine whether significant differences existed among the three auditory memory span groups on listening vocabulary comprehension. Although one-way analysis of variance indicated observable differences among the means of the three groups on listening vocabulary comprehension, the Scheffé comparison of means indicated no significant differences among the HAMS, MAMS, and LAMS.

This hypothesis was upheld for all three groups on the basis of the Scheffé Tests.

The difference emerging between the mean scores of the HAMS and the LAMS was tested by the 't' Test for independent samples. The analysis of the results indicated a significant ($p<.01$) difference between the HAMS and the LAMS on listening vocabulary comprehension. Thus the portion of the hypothesis pertaining to the HAMS and the LAMS is rejected on the basis of the Welch 'T' prime adjustment.

b) This hypothesis was accepted on the basis of the Scheffé Tests

and 't' Test since the HAMS, the MAMS, and the LAMS did not differ significantly in their performance on listening paragraph comprehension.

c) This hypothesis was upheld on the basis of Scheffe Test for all the three groups on total listening comprehension. No significant differences were found between the mean scores of HAMS and LAMS; nor between the mean scores of HAMS and LAMS; or between the mean scores of MAMS and LAMS.

Significant differences ($p < .01$) between the mean scores of HAMS and LAMS on the total listening comprehension emerged when the Welch 'T' prime adjustment of 't' Tests for unequal variances was applied to account for unequal number in each group. Therefore, the portion of the the hypothesis pertaining to HAMS and LAMS was rejected on the basis of the 't' Test for the total listening comprehension.

Conclusion

These results suggest that auditory memory span is a distinguishing factor in differentiating the degree of success in listening vocabulary. Students with a low auditory memory span tend to score low in listening vocabulary, while children with average auditory memory span maintain an intermediate position on all the listening comprehension variables. This phenomenon may indicate that students with high auditory memory spans may have better strategies for association and retention of word meanings.

The analysis of the data indicated that the HAMS and LAMS differ

significantly in their mean scores on listening vocabulary and total listening comprehension, but similar pattern did not emerge for listening paragraph comprehension. These results suggest that the total listening comprehension depends heavily on listening vocabulary. Furthermore, this finding provides evidence supporting the contention of Cole (1946), Laban (1966), and Goodman (1970) that inadequate vocabulary is the greatest single cause for failure to comprehend.

An interesting observation in the investigation of Hypothesis 4 was that listening paragraph comprehension failed to distinguish between the high and the low auditory memory span groups. These results suggest that listening paragraph comprehension may be relatively less dependent on auditory stimuli than reading paragraph comprehension, and less prone to accurate associations which are called upon in literal comprehension. Results from the previous hypotheses tend to substantiate the foregoing: that relatively low correlations were established between listening paragraph comprehension and auditory memory span sub-tests. These results appear to be quite reasonable as in listening paragraph comprehension all the information must be held in the auditory memory span until the instructions are given at the end of each passage as to what aspects to recall. This is generally not possible due to the limited capacity of the immediate memory span according to Miller (1956), Broadbent (1966), Mandler (1968) and others cited in Chapter II.

Hypothesis 5

There is no significant difference between the scores obtained by high, middle and low auditory memory span groups on comprehension of:

a) Reading vocabulary,

b) Reading paragraphs, and

c) Total reading.

a) This hypothesis is upheld since Scheffé comparisons of means revealed no significant differences between the HAMS and the MAMS; the HAMS and the LAMS; or the MAMS and the LAMS on reading vocabulary comprehension.

The same hypothesis is rejected for HAMS and LAMS on the basis of the 't' Test which revealed a significant difference ($p < .01$) between these two groups on reading vocabulary.

b) This hypothesis is upheld on the basis of Scheffé Tests which showed no significant differences between the HAMS and the MAMS; the HAMS and the LAMS, or the MAMS and the LAMS in reading paragraph comprehension.

The same hypothesis is rejected for HAMS and LAMS on the basis of the 't' Test which disclosed a significant difference ($p < .01$) in reading paragraph comprehension.

c) This hypothesis is sustained on the basis of Scheffé analysis which revealed no significant differences among the HAMS, MAMS and the LAMS on total reading comprehension.

The same hypothesis is rejected for HAMS and LAMS on the basis of

the 't' Test which revealed significant differences ($p < .01$) in total reading comprehension.

Conclusion

The analysis of the data suggests that, had the variances within the groups of this sample been maximum, the differences might have been more pronounced on Scheffe analysis as opposed to 't' test. Seeing that the groups were selected from within a sample of average ability students in a normal classroom, these results may have been inevitable.

However, the 't' Test for independent samples indicated that reading vocabulary and reading paragraph comprehension differentiates between the high and low auditory memory span groups. It may be concluded that deficiency in auditory memory span is reflected in children's reading vocabulary and reading paragraph comprehension. In other words, the results tend to suggest that within this sample, children with high auditory memory span are able to cope efficiently with reading vocabulary and reading paragraph comprehension measures. Children with low auditory memory span have a tendency to score low in reading vocabulary and reading paragraph comprehension.

Hypothesis 6

There is no significant relationship between the scores on listening and reading comprehension when auditory memory span is partialled out.

When the effect of auditory memory span was partialled out, the

correlation coefficient between listening and reading comprehension was reduced to a lesser degree but continued to be statistically significant ($p < .01$). Therefore, this hypothesis is rejected for the total sample.

Conclusion

From the statistical analysis of the data, it is evident that a significant relationship does exist between the two receptive aspects of language arts subsequent to partialling out the effect of the auditory memory span. The findings reveal that even though auditory memory span accounts for little overlap between listening and reading comprehension, its relationship to the two respective aspects of language is significant. A possible interpretation of this finding is that short auditory memory span may be accompanied by poor listening and reading comprehension abilities among average ability children.

However, it may be said that excellence in both the receptive aspects of communication calls upon factors other than those tested in the auditory memory span sub-tests. These findings support the conclusions of the theoretical discussion of Chapter II.

III. IMPLICATION FOR EDUCATION

The findings and conclusions from this study suggest several pertinent implications for the classroom teachers and those who are concerned with the teaching of remedial reading:

1. Analysis of the data revealed highest correlation occurred between the scores on Element Memory Span and Related Syllable Memory Span

and the scores in listening and reading comprehension. This finding suggests that perhaps, teachers should focus their attention on training students in auditory discrimination and making them aware of semantic and syntactic relationships of words in order to enhance children's understanding of these language units, thus facilitating their comprehension ability.

2. The results of the study showed that Element Memory Span and Related Syllable Memory Span may be used as diagnostic instruments by the teacher or a reading clinician to screen children who are likely to have difficulty in both listening and reading comprehension. In this manner, appropriate remedial measures may be provided for these children to circumvent their difficulty. It has been indicated in the study that auditory memory span may be a possible cause of low comprehension ability. Thus, it is suggested that children be identified for deficient auditory memory span at an early stage.

3. The present results of the study revealed that students with longer memory span differ significantly from students with short auditory memory span on their performances in comprehension measures. Direct training to improve retention in the auditory memory span may prove to be useful for some children.

One way would be to ask the child to repeat a sequence of letters soon after the presentation. The sequences could be made longer after each successful trial. A verification of this exercise may be to repeat a sequence of letters twice, leaving one letter out the second time. The child is asked to name the missing letter. The exercises may be verified by using elements, and sentences in place of letters.

In the initial stages, children may be trained to subvocalize or rehearse the presented input. This will increase the efficiency of the memory span capacity by recirculating the information, which might have been forgotten or lost, back into the short-term memory storage. It is recommended that memory span drills be integrated into the total comprehension program.

4. In the light of the fact that a significant relationship exists between auditory memory span and both aspects of acquiring vocabulary mainly listening and reading, it may be suggested to familiarize students with variety of words through meaningful activities such as television programs, field trips, creative drama, and art. These will help extend the child's range of experiences, leaving memory images and expanding word meanings from which he draws in the process of auding and reading.

IV. SUGGESTIONS FOR FURTHER RESEARCH

The findings of the study gave rise to a number of suggestions which could be further explored:

1. In the process of conducting this investigation, the researcher noticed that children's immediate recall of the presented items (of the auditory memory span sub-tests) was productive as well as 'reproductive'. This study may be extended with an added dimension to the Auditory Memory Span Test. There should be two types of scores for every response: one score should be given for the immediate sequential response or the reproductive response, and another score for the recoded or the productive response as comprehension is productive as well as reproductive. Listen-

ing and reading comprehension may be measured by oral and written Cloze procedure respectively.

2. According to the findings, a regular classroom with average ability children tends to have a very small within group variance for the auditory memory span. The sample should be drawn from a wider population to obtain a normal distribution with a maximum variance. Thus heterogeneous groups should be employed containing for instance, high and low reading achievers.

3. It is further recommended that the effects of training on auditory memory span at the elementary grade level with a matched experimental and a control group be investigated. The aim of such an investigation would be to determine whether training in this area would increase the number of information items held and, if so, whether the increase is reflected in children's performance in listening and reading.

4. A study might be conducted to determine the effects of environment on auditory memory span for various stimuli such as letters, elements, sentences, musical notes, male and female voices. The sample would consist of children from high and low socio-economic status. The performance of the two groups on the battery of auditory memory span test would be compared to their listening and reading comprehension abilities.

5. In a normal life situation, it is inevitable that both visual and auditory memory span will be used. A longitudinal study may be profitably conducted using forward visual span, forward and backwards auditory memory span. The results of both visual and auditory memory span may be correlated to each other and to listening and reading comprehension scores. The results may provide additional evidence regarding the size of the span in relation to modality preference.

6. It would be interesting to find out if the number of information items which can be held in the auditory memory span differs from one culture to another. For example, do Chinese have a longer memory span than the North Americans? Do illeterate people in underdeveloped countries have a longer span than literate people, since the former have to depend more on their memory than the latter?

7. The factor of 'interest' in the material presented should be the object of future research. Several studies have implied that interest in materials may be an important factor in the ability to comprehend and recall information.

8. Finally, it is suggested that this study be replicated at other grade levels using auditory stimuli such as letters forwards and backwards, elements, words in isolation and words in context. Longitudinal information on children's working of memory span in relation to their listening and reading comprehension abilities would be valuable to determine how children develop these abilities.

V. CONCLUDING STATEMENT

This study included correlation of grade four children's performance on auditory memory span-subtests, listening and reading comprehension.

The relationship between auditory memory span and the two aspects of acquiring information, namely listening and reading, were investigated. It was found that auditory memory span had low significant correlation with comprehension measures. The highest statistical significant correlation was found with listening and reading vocabulary. Reading para-

graph comprehension was more significantly correlated to auditory memory span than listening paragraph comprehension. When auditory memory span was partialled out, a significant relationship continued to exist between listening and reading comprehension abilities at the .01 level for the total sample. It was concluded that auditory memory span involves little overlap between the two processes of communication namely listening and reading. The 't' Test for independent samples indicated that the high auditory memory span group differed significantly from the low group in listening vocabulary, total listening comprehension, reading vocabulary, reading paragraph comprehension, and total reading comprehension.

The most significant relationship was found between the scores on auditory memory span and the scores on listening and reading vocabulary. Thus, it is possible to conclude that deficient auditory memory span may be a causal factor for low ability in listening and reading vocabulary. Furthermore, the analysis of the correlation coefficients between vocabulary (listening and reading) and paragraph comprehension (listening and reading) suggested that understanding of the meanings of words may be central to the comprehension of the passages. This finding lends support to David (1942), Gray (1952), Hunt (1957), Spearritt (1962), Goodman (1966) who maintained that deficiency in word meanings is the main cause of comprehension failure among elementary school children. Laban (1963, 1966) in his longitudinal study indicated that children who begin school deficient in vocabulary also reveal a low level of concept formation and they continue to exhibit difficulty in reading comprehension throughout the elementary grades.

It seems reasonable to conclude that subjects in this sample who exhibited superior ability in auditory memory span were almost always successful in listening and reading comprehension, but those who were deficient in auditory memory span displayed relatively low ability to comprehend information presented visually and aurally. In conclusion, poor listening and reading comprehension abilities are almost always allied with deficient auditory memory span among average ability children.

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APPENDIX

APPENDIX

AUDITORY MEMORY SPAN TEST:

LETTER MEMORY SPAN

ELEMENT MEMORY SPAN

UNRELATED SYLLABLE MEMORY SPAN

RELATED SYLLABLE MEMORY SPAN

DIRECTION FOR THE AUDITORY MEMORY SPAN TEST

Directions for Letter Memory Span:

"I am going to say some letters to you. When I stop, I want you to repeat them in the same order that I said them."

Directions for the Element Memory Span, Unrelated Syllable Memory Span, and Related Syllable Memory Span were similar except 'parts of the words', 'words' and 'sentences' were substituted for 'letters'.

LETTER MEMORY SPAN

School ..... Subject .....

Letters Forward

Samples: H U

I B

X C .....

E K .....

H G X .....

K F L .....

R H K A .....

O S F B .....

S R L B X .....

R G I X F .....

H L A U I L .....

A K G L S O .....

U W B I C J R .....

Y O A Q S E B .....

F X I G J B Y Q .....

C E S E J B R X .....

G I E S R L J B U .....

R J F Y E Q J Y H .....

PART 2: ELEMENT MEMORY SPAN

School ..... Subject .....

1. sut
   tid
   fen

2. a gard
   be haps
   bro ter

3. for i sult
   ex plete ly
   in fas try

4. sim tur son dle
   val es pen cial
   ad day pic ord

5. la jec te ri al
   per di lon sup low
   e pro mis cep tice

6. dis ap pose hap li mous
   can er bet un var tance
   rap unc to pub lem id

7. won di mu sand lic yond den
   ap to get i graph al ly
   pleas a quar ten dee dent er

UNRELATED SYLLABLE MEMORY SPAN

School ..... Subject .....

2a cat ice
2b dog ship

3a man horse song
3b pen girl cow

4a cave bird desk road
4b chair hen book vest

5a head milk dress oats night
5b pipe west fence coat mule

6a fish clock heart sun box frog
6b stone blot freeze door cut white

7a skirt plant friends east tub barn hair
7b mud vase noth ten rain cross shoe

8a ear boat key pig south knob ink rope
8b four skate fan spend lamp wool axe toad

RELATED SYLLABLE MEMORY SPAN

School ..... Subject .....

1. My doll has pretty hair.
2. We will go for a walk.
3. My dog chases the white cat.
4. Our new car has four red wheels.
5. Henry likes to read his new book.
6. Bring the broom and sweep the front room.
7. The bell on the engine rings loudly.
8. On Sundays all of us go to church.
9. In summer we go North where it is cool.
10. Green leaves come on the trees in early spring.
11. The airplane makes a loud noise when it flies fast.
12. We saw a little fire on the way to school.
13. The sun shone brightly today and it hurt my eyes.
14. The men painted our new house white with dark green blinds.
15. They gave me some pretty shoes for my birthday last month.
16. The art teacher comes to our own school three days a week.
17. Ten persons went to a party where there was lots to eat.
18. Three boys spent a happy day last week on a fishing trip.
19. On Tuesday for lunch we had some fresh bread which out mother baked.
20. Father must buy some new license plates for his car once each year.
21. When the train passes the whistle blows for us to keep off the track.
22. In the summer time the nights are very short and the days are long.
23. We had a party for Jean last Monday with cake and ice cream to eat.

24. At eight we go to bed and mother reads to us from our story books.
25. Each year when the big circus comes to town father takes the whole family.
26. Many boys and girls go to the movies on nights at the end of each week.
27. My sister Mary has a pretty new doll which shuts its eyes and goes to sleep.
28. The man who lives next door is a good neighbor and invites us for many rides.
29. Last winter we made a big round snow man and put a little black hat on his head.
30. In my uncle's home there was a soft red carpet on the floor of the living room.
31. The day of the football game the weather was clear but chilly and the wind blew briskly.
32. Because there were few vacant lots the police roped off our street so that we might be safe.
33. On the Fourth of July my father puts on his army suit and joins his friends on parade.
34. In fair weather and at high tide ships from many nations set sail for their own distant ports.
35. The baseball team from our high school played fifteen games; they lost six but they ended in second place.
36. Last night there was a large banquet at the hotel where many people dined and had a pleasant time.
37. Our reading books at school have many fine stories which are short but very full of life and action.

38. In the north country the days are very short in winter and the sun hangs low in the southern sky.
39. China closets filled with all kinds of dainty dishes and cut glass lined the large walls of the dining room.
40. On cold, clear nights hundreds of thousands of twinkling start shine brightly from their cradles far up in the sky.
41. In the heart of the Congo there are many kinds of beasts which are a nightly terror to the black natives.
42. Down near the bank of the river is an estate from which sound the shouts of happy children hour after hour.
43. Each four years voting takes place which results in many men being placed in office for terms of two years or more.